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Langley Research Center

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NASA STI Program ... in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program plays a key part in helping NASA maintain this important role.

The NASA STI Program provides access to the NASA STI Database, the largest collection of aeronautical and space science in the world. The STI Program is also NASA's institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

- **TECHNICAL PUBLICATION.** Reports of completed research or major significant phases of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed of continuing reference value. NASA counterpart of peer-reviewed formal professional papers, but has less stringent limitations on manuscript length and extent of graphic presentations.
- **TECHNICAL MEMORANDUM.** Scientific and technical findings that are of preliminary or specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
- **CONTRACTOR REPORT.** Scientific and technical findings by NASA-sponsored contractors and grantees.
- **CONFERENCE PUBLICATION.** Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or co-sponsored by NASA.

- **SPECIAL PUBLICATION.** Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.
- **TECHNICAL TRANSLATION.** English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services that help round out the STI Program's diverse offerings include creating custom thesauri, building customized databases, organizing and publishing research results ... even providing videos.

The NASA STI Program is managed by the NASA STI Program Office (STIPO). STIPO is the administrative office at Langley Research Center for the NASA STI Program.

For more information about the NASA STI Program, you can:

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Introduction

Scientific and Technical Aerospace Reports (STAR) is an online information resource listing citations and abstracts of NASA and world wide aerospace-related STI. Updated biweekly, *STAR* highlights the most recent additions to the NASA STI Database. Through this resource, the NASA STI Program provides timely access to the most current aerospace-related Research & Development (R&D) results.

STAR subject coverage includes all aspects of aeronautics and space research and development, supporting basic and applied research, and application, as well as aerospace aspects of Earth resources, energy development, conservation, oceanography, environmental protection, urban transportation and other topics of high national priority. The listing is arranged first by 11 broad subject divisions, then within these divisions by 76 subject categories and includes two indexes: subject and author.

STAR includes citations to Research & Development (R&D) results reported in:

- NASA, NASA contractor, and NASA grantee reports
- Reports issued by other U.S. Government agencies, domestic and foreign institution, universities, and private firms
- Translations
- NASA-owned patents and patent applications
- Other U.S. Government agency and foreign patents and patent applications
- Domestic and foreign dissertations and theses

The NASA STI Program

The NASA Scientific and Technical Information (STI) Program was established to support the objectives of NASA's missions and research to advance aeronautics and space science. By sharing information, the NASA STI Program ensures that the U.S. maintains its preeminence in aerospace-related industries and education, minimizes duplication of research, and increases research productivity.

Through the NASA Center for AeroSpace Information (CASI), the NASA STI Program acquires, processes, archives, announces and disseminates both NASA's internal STI and world-wide STI. The results of 20th and 21st century aeronautics and aerospace research and development, a worldwide investment totaling billions of dollars, have been captured, organized, and stored in the NASA STI Database. New information is continually announced and made available as it is acquired, making this a dynamic and historical collection of value to business, industry, academia, federal institutions, and the general public.

The STI Program offers products and tools that allow efficient access to the wealth of information derived from global R&D efforts. In addition, customized services are available to help tailor this valuable resource to meet your specific needs.

For more information on the most up to date NASA STI, visit the STI Program's website at <http://www.sti.nasa.gov>.

NASA STI Availability Information

NASA Center for AeroSpace Information (CASI)

Through NASA CASI, the NASA STI Program offers many information products and services to the aerospace community and to the public, including access to a selection of full text of the NASA STI. Free registration with the program is available to NASA, U.S. Government agencies and contractors. To register, contact CASI at help@sti.nasa.gov. Others should visit the program at www.sti.nasa.gov. The 'search selected databases' button provides access to the CASI TRS – the publicly available contents of the NASA STI Database.

Each citation in *STAR* indicates a 'Source of Availability'. When CASI is indicated, the user can order this information directly from CASI using the [STI Online Order Form](#) or contact help@sti.nasa.gov or telephone the CASI Help Desk at 301-621-0390. Before ordering you may access price code tables for STI [documents](#) and [videos](#). When information is not available from CASI, the source of the information is indicated when known.

NASA STI is also available to the public through federal information organizations. NASA CASI disseminates publicly available NASA STI to the National Technical Information Service (NTIS) and to the Federal Depository Library Program (FDLP) through the Government Printing Office (GPO). In addition, NASA patents are available online from the U.S. Patent and Trademark Office.

National Technical Information Service (NTIS)

The National Technical Information Service serves the American public as a central resource for unlimited, unclassified U.S. Government scientific, technical, engineering, and business related information. For more than 50 years NTIS has provided businesses, universities, and the public timely access to well over 2 million publications covering over 350 subject areas. Visit NTIS at <http://www.ntis.gov>.

The Federal Depository Library Program (FDLP)

The U.S. Congress established the **Federal Depository Library Program** (FDLP) to ensure access by the American public to U.S. Government information. The program acquires and disseminates information products from all three branches of the U.S. Government to nearly 1,300 Federal depository libraries nationwide. The libraries maintain these information products as part of their existing collections and are responsible for assuring that the public has free access to the information. Locate the Federal Depository Libraries http://www.access.gpo.gov/su_docs.

The U.S. Patent and Trademark Office (USPTO)

The U.S. Patent and Trademark Office provides online access to full text patents and patent applications. The database includes patents back to 1976 plus some pre-1975 patents. Visit the USPTO at <http://www.uspto.gov/patft/>.

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[Subject Term Index](#)

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SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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01

AERONAUTICS (GENERAL)

Includes general research topics related to manned and unmanned aircraft and the problems of flight within the Earth's atmosphere. Also includes manufacturing, maintenance, and repair of aircraft. For specific topics in aeronautics, see *categories 02 through 09*. For information related to space vehicles see *12 Astronautics*.

20030053128 Nebraska Univ., Omaha, NE, USA

Partnership and the Revitalization of Aviation: A Study of the Advanced General Aviation Transport Experiments Program, 1994-2001

Metz, Nanette Scarpellini; 2002; 38 pp.; In English

Report No.(s): UNOAI-02-5; Copyright; Avail: CASI; [A03](#), Hardcopy

As the Advanced General Aviation Transport Experiments (AGATE) program completes its eight-year plan, the outcomes and industry effects reveal its successes and problems. AGATE engaged several different types of institutions, including federal agencies, business and industry, universities, and non-profit organizations. By examining the perceptions of those intimately involved as well as periphery members, this study shows the powerful consequences of this type of combination both now and in the future. The problems are a particularly useful illustration of the interworking of a jointly funded research and development initiative. By learning how these problems are addressed, the study reveals lessons that may be applied to future government-industry partnerships.

Author

General Aviation Aircraft; Air Transportation; NASA Programs; Government/Industry Relations

02

AERODYNAMICS

Includes aerodynamics of flight vehicles, test bodies, airframe components and combinations, wings, and control surfaces. Also includes aerodynamics of rotors, stators, fans, and other elements of turbomachinery. For related information see also *34 Fluid Mechanics and Thermodynamics*.

20030053190 NASA Langley Research Center, Hampton, VA, USA

Profile Optimization Method for Robust Airfoil Shape Optimization in Viscous Flow

Li, Wu; May 2003; 14 pp.; In English

Contract(s)/Grant(s): WU 762-20-61-01

Report No.(s): NASA/TM-2003-212408; L-18283; NAS 1.15:212408; No Copyright; Avail: CASI; [A03](#), Hardcopy

Simulation results obtained by using FUN2D for robust airfoil shape optimization in transonic viscous flow are included to show the potential of the profile optimization method for generating fairly smooth optimal airfoils with no off-design performance degradation.

Author

Shape Optimization; Airfoils; Viscous Flow

20030053340 NASA Dryden Flight Research Center, Edwards, CA, USA

Airfoil Shaped Flow Angle Probe

Corda, Stephen, Inventor; Vachon, Michael Jake, Inventor; March 04, 2003; 6 pp.; In English; Original contains black and white illustrations

Patent Info.: Filed 18 Jul. 2001; US-Patent-6,526,821; US-Patent-Appl-SN-909166; NASA-Case-DRC-00100-9; No Copyright; Avail: CASI; [A02](#), Hardcopy

The present invention is a force-based instrument that measures local flow angle. The preferred embodiment of the invention has a low aspect ratio airfoil member connected to a mounting base. Using a series of strain gauges located at the connecting portion of the probe, aerodynamic forces on the airfoil member can be converted to strain, which in turn can be converted to local air flow measurements. The present invention has no moving parts and is well suited for measuring flow in a transonic and supersonic regime.

Author

Airfoils; Flow Measurement; Air Flow; Flow Direction Indicators

03

AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; airport ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in *09 Research and Support Facilities (Air)*. Air traffic control is covered in *04 Aircraft Communications and Navigation*. For related information see also *16 Space Transportation and Safety* and *85 Technology Utilization and Surface Transportation*.

20030053131 Nebraska Univ., Omaha, NE, USA

Annotated Bibliography of Enabling Technologies for the Small Aircraft Transportation System

ONeil, Patrick D.; Tarry, Scott E.; May 2002; 52 pp.; In English

Report No.(s): UNOAI-02-3; Copyright; Avail: CASI; [A04](#), Hardcopy

The following collection of research summaries are submitted as fulfillment of a request from NASA LaRC to conduct research into existing enabling technologies that support the development of the Small Aircraft Transportation System aircraft and accompanying airspace management infrastructure. Due to time and fiscal constraints, the included studies focus primarily on visual systems and architecture, flight control design, instrumentation and display, flight deck design considerations, Human-Machine Interface issues, and supporting augmentation technologies and software. This collation of summaries is divided in sections in an attempt to group similar technologies and systems. However, the reader is advised that many of these studies involve multiple technologies and systems that span across many categories. Because of this fact, studies are not easily categorized into single sections. In an attempt to help the reader more easily identify topics of interest, a SATS application description is provided for each summary. In addition, a list of acronyms provided at the front of the report to aid the reader. Derived from text

Civil Aviation; General Aviation Aircraft; Flight Management Systems; Air Traffic Control; Aircraft Design; Bibliographies

20030053136 Nebraska Univ., Omaha, NE, USA

The Airline Quality Rating 2002

Bowen, Brent D.; Headley, Dean E.; April 2002; 56 pp.; In English

Report No.(s): UNOAI-02-2; Copyright; Avail: CASI; [A04](#), Hardcopy

The Airline Quality Rating (AQR) was developed and first announced in early 1991 as an objective method of comparing airline quality on combined multiple performance criteria. This current report, Airline Quality Rating 2002, reflects monthly Airline Quality Rating scores for 2001. AQR scores for the calendar year 2001 are based on 15 elements that focus on airline performance areas important to air travel consumers. The Airline Quality Rating 2002 is a summary of month-by-month quality ratings for the 11 largest U.S. airlines operating during 2001. Using the Airline Quality Rating system of weighted averages and monthly performance data in the areas of on-time arrivals, involuntary denied boardings, mishandled baggage, and a combination of 12 customer complaint categories, airlines comparative performance for the calendar year of 2001 is reported. This research monograph contains a brief summary of the AQR methodology, detailed data and charts that track comparative quality for domestic airline operations for the 12-month period of 2001, and industry average results. Also, comparative Airline Quality Rating data for 2000 are included for each airline to provide historical perspective regarding performance quality in the industry.

Author

Airline Operations; Air Transportation; Commercial Aircraft; Consumers; Surveys; Evaluation; Passengers

20030055156 NASA Marshall Space Flight Center, Huntsville, AL, USA

Digital Avionics

Koelbl, Terry G.; Ponchak, Denise; Lamarche, Teresa; [2002]; 5 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; [A01](#), Hardcopy

The field of digital avionics experienced another year of important advances in civil aviation, military systems, and space applications. As a result of the events of 9/11/2001, NASA has pursued activities to apply its aerospace technologies toward improved aviation security. Both NASA Glenn Research Center and Langley Research Center have performed flight research demonstrations using advanced datalink concepts to transmit live pictures from inside a jetliner, and to downlink the contents of the plane's 'black box' recorder in real time. The U.S. Navy and General Electric demonstrated survivable engine control (SEC) algorithms during engine ground tests at the Weapons Survivability Laboratory at China Lake. The scientists at Boeing Satellite Systems advanced the field of stellar inertial technology with the development of a new method for positioning optical star trackers on satellites.

Author

Flight Management Systems; Systems Integration; Digital Systems; Aircraft Safety; Data Links; Wireless Communication; Applications Programs (Computers); Technology Utilization

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology. For related information see also *18 Spacecraft Design, Testing and Performance*; and *39 Structural Mechanics*. For land transportation vehicles see *85 Technology Utilization and Surface Transportation*.

20030053161 NASA Dryden Flight Research Center, Edwards, CA, USA

The Active Aeroelastic Wing Phase I Flight Research Through January 2003

Voracek, David; Pendleton, Ed; Reichenbach, Eric; Griffin, Kenneth; Welch, Leslie; April 2003; 25 pp.; In English; Applied Vehicle Technology Panel (AVT) Symposium on Novel and Emerging Vehicle and Vehicle Technology Concepts, 7-9 April 2003, Brussels, Belgium

Contract(s)/Grant(s): WU 710-61-14; Proj-SE-1400-AAW

Report No.(s): NASA/TM-2003-210741; NAS 1.15:210741; H-2521; Copyright; Avail: CASI; [A03](#), Hardcopy

This report describes the technical content of the Active Aeroelastic Wing (AAW) Flight Research Program and discusses the analytical development, aircraft test bed modifications, ground test results, and flight research results through January 2003. The goals of the AAW Flight Research Program are to demonstrate, in full scale, AAW technology, and to measure the aerodynamic, structural, and flight control characteristics associated with the AAW aircraft. Design guidance, derived from the results of this benchmark flight program, will be provided for implementation on future aircraft designs.

Author

Aeroelasticity; F-18 Aircraft; Control Surfaces; Aircraft Design; Aerodynamics; Flight Control; Structural Design; Design Analysis

07

AIRCRAFT PROPULSION AND POWER

Includes primary propulsion systems and related systems and components, e.g., gas turbine engines, compressors, and fuel systems; and onboard auxiliary power plants for aircraft. For related information see also *20 Spacecraft Propulsion and Power*; *28 Propellants and Fuels*; and *44 Energy Production and Conversion*.

20030054519 Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, USA

A Design Methodology for Rapid Implementation of Active Control Systems Across Lean Direct Injection Combustor Platforms

Baumann, William T.; Saunders, William R.; Vandsburger, Uri; Saus, Joseph, Technical Monitor; April 2003; 23 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NAG3-2687; WU-708-87-23

Report No.(s): NASA/CR-2003-212197; E-13800; NAS 1.26:212197; No Copyright; Avail: CASI; [A03](#), Hardcopy

The VACCG team is comprised of engineers at Virginia Tech who specialize in the subject areas of combustion physics, chemical kinetics, dynamics and controls, and signal processing. Currently, the team's work on this NRA research grant is

designed to determine key factors that influence combustion control performance through a blend of theoretical and experimental investigations targeting design and demonstration of active control for three different combustors. To validate the accuracy of conclusions about control effectiveness, a sequence of experimental verifications on increasingly complex lean, direct injection combustors is underway. During the work period January 1, 2002 through October 15, 2002, work has focused on two different laboratory-scale combustors that allow access for a wide variety of measurements. As the grant work proceeds, one key goal will be to obtain certain knowledge about a particular combustor process using a minimum of sophisticated measurements, due to the practical limitations of measurements on full-scale combustors. In the second year, results obtained in the first year will be validated on test combustors to be identified in the first quarter of that year. In the third year, it is proposed to validate the results at more realistic pressure and power levels by utilizing the facilities at the Glenn Research Center.

Author

Active Control; Combustion Control; Injectors; Fuel Injection; Combustion Chambers

12

ASTRONAUTICS (GENERAL)

Includes general research topics related to space flight and manned and unmanned space vehicles, platforms or objects launched into, or assembled in, outer space; and related components and equipment. Also includes manufacturing and maintenance of such vehicles or platforms. For specific topics in astronautics see *categories 13 through 20*. For extraterrestrial exploration see *91 Lunar and Planetary Science and Exploration*.

20030053368 NASA Kennedy Space Center, Cocoa Beach, FL, USA

STS-111/Endeavour/ISS UF2 Landing with Playbacks

June 19, 2002; In English; No Copyright; Avail: CASI; [V04](#), Videotape-VHS; [B04](#), Videotape-Beta

Footage of the STS-111 Endeavour landing at Edwards Air Force base in California is shown. Shots of the mission control room, the shuttle's re-entry into Earth's atmosphere and the landing strip at Edwards Air Force base are seen. The STS-111 flight crew (Pilot Paul Lockhart; Mission Specialist Franklin Chang-Diaz; Mission Specialist Phillippe Perrin) delivered the Expedition Five crew (ISS Commander Valery Kozun; Flight Engineer Peggy Whitson; Flight Engineer Sergei Treschev) to the International Space Station and returned the Expedition Four crew (ISS Commander Yuri Onufrienko; Flight Engineer Daniel Bursch; Flight Engineer Carl Walz) to Earth.

CASI

Space Transportation System Flights; Endeavour (Orbiter); Spacecraft Landing; Crew Procedures (Inflight); Ground Based Control

15

LAUNCH VEHICLES AND LAUNCH OPERATIONS

Includes all classes of launch vehicles, launch/space vehicle systems, and boosters; and launch operations. For related information see also *18 Spacecraft Design, Testing and Performance*; and *20 Spacecraft Propulsion and Power*.

20030054530 NASA Kennedy Space Center, Cocoa Beach, FL, USA

STS-98 Meal - Suit up - Depart O and C - Launch Atlantis On Orbit - Landing - Crew Egress

February 20, 2001; In English; No Copyright; Avail: CASI; [V04](#), Videotape-VHS; [B04](#), Videotape-Beta

The crewmembers of the STS-98 include: Pilot Mark Polansky, Commander Kenneth Cockrell, and Mission Specialists Robert Curbeam, Thomas Jones, and Marsha Ivins. The astronauts are shown during suitup, departure of the Operations and Check-Out (O&C) Building and Ingress. Also, the launch of the STS-98 Atlantis is presented from various vantage points such as the Shuttle Landing Facility (SLF) Convoy, Beach Tracker, Vehicle Assembly Building (VAB) Roof, Pad-A Perimeter, Tower-1, and Grandstand. Live footage of the docking of Atlantis with the International Space Station (ISS) is shown and the opening of the Atlantis/ISS hatch is also presented. Mission Specialists Robert Curbeam and Thomas Jones are shown performing On Orbit Extravehicular Activities (EVA's) during this mission. A camera view of the undocking of the Space Shuttle Atlantis and the landing of the Space Shuttle Atlantis at the Dryden Flight Research Facility along with flight crew Egress is also presented.

CASI

Space Transportation System; Atlantis (Orbiter); Space Shuttles; Spacecrews; Egress; Spacecraft Launching

SPACE TRANSPORTATION AND SAFETY

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information see also *03 Air Transportation and Safety*; *15 Launch Vehicles and Launch Operations*; and *18 Spacecraft Design, Testing and Performance*. For space suits see *54 Man/System Technology and Life Support*.

20030053354 NASA Kennedy Space Center, Cocoa Beach, FL, USA

STS-100 Photo-op/Shut-up/Depart O&C/Launch Endeavour On Orbit/Landing/Crew Egress

May 1, 2001; In English; No Copyright; Avail: CASI; [V04](#), Videotape-VHS; [B04](#), Videotape-Beta

This video shows an overview of crew activities from STS-100. The crew of Space Shuttle Endeavour includes: Commander Kent Rominger; Pilot Jeffrey Ashby; and Mission Specialists Chris Hadfield, John Phillips, Scott Parazynski, Umberto Guidoni, and Yuri Lonchakov. Sections of the video include: Photo-op; Suit-up; Depart O&C; Ingress; Launch with Playbacks; On-orbit; Landing with Playbacks; Crew Egress & Departure. Voiceover narration introduces the astronauts at their pre-flight meal, and continues during the video, except for the launch and landing sequences. Launch playback views include: NEXT; Beach Tracker; VAB; PAD-A; Tower-1; UCS-15; Grandstand; OTV-60; OTV-70; OTV-71; DOAMS; UCS-10 Tracker; UCS-23 Tracker; On-board Ascent Camera. The On-orbit section of the video shows preparations for an extravehicular activity (EVA) to install Canadarm 2 on the International Space Station (ISS). Preparation for docking with the ISS, and the docking of the orbiter and ISS are shown. The attachment of Canadarm 2 and the Raffaello Logistics Module, a resupply vehicle, are shown. The crew also undertakes some maintenance of the ISS. Landing playback views include: TV-1; TV-2; LRO-1; LRO-2; PPOV.

CASI

Endeavour (Orbiter); International Space Station; Spacecrews; Space Station Mobile Servicing System; Liftoff (Launching); Horizontal Spacecraft Landing; Orbital Assembly

20030053426 NASA Glenn Research Center, Cleveland, OH, USA

Research Needs in Fire Safety for the Human Exploration and Utilization of Space

Ruff, Gary A.; Research Needs in Fire Safety for the Human Exploration and Utilization of Space Proceedings and Research Plan; April 2003, pp. 19-25; In English; See also 20030053425; Original contains color illustrations; No Copyright; Avail: CASI; [A02](#), Hardcopy

This viewgraph presentation provides information on developments in spacecraft fire safety research. The presentation includes an overview of the previous Spacecraft Fire Safety Workshop, from 1986, and the influences since then of bioastronautics on combustion science and fire safety. The presentation then gives an overview of the current conference, stating goals and giving a schedule.

CASI

Fire Prevention; Aerospace Safety; Bioastronautics; Conferences; Manned Spacecraft; Fires

20030053428 NASA Marshall Space Flight Center, Huntsville, AL, USA

Control of Materials Flammability Hazards

Griffin, Dennis E.; Research Needs in Fire Safety for the Human Exploration and Utilization of Space: Proceedings and Research Plan; April 2003, pp. 35-47; In English; See also 20030053425; No Copyright; Avail: CASI; [A03](#), Hardcopy

This viewgraph presentation provides information on selecting, using, and configuring spacecraft materials in such a way as to minimize the ability of fire to spread onboard a spacecraft. The presentation gives an overview of the flammability requirements of NASA-STD-6001, listing specific tests and evaluation criteria it requires. The presentation then gives flammability reduction methods for specific spacecraft items and materials.

CASI

Flammability; Fires; Aerospace Safety; Flame Propagation

20030053442 NASA Kennedy Space Center, Cocoa Beach, FL, USA

STS 87: Meal - Suit Up - Depart O&C - Launch Columbia On Orbit - Landing - Crew Egress

December 05, 1997; In English; No Copyright; Avail: CASI; [V04](#), Videotape-VHS; [B04](#), Videotape-Beta

The STS-87 Space Shuttle Columbia mission begins with the introduction of the seven crew members. The seven crew members include: Commander Kevin R. Kregel, pilot Steven W. Lindsey, mission specialists: Winston E. Scott, Kalpana Chawla and Takao Doi and payload specialist Leonid K. Kadenyuk. The USA Microgravity Payload (USMP-4), Orbital Acceleration Research Experiment (OARE), the EVA Demonstration Flight Test 5 (EDFT-05), Shuttle Ozone Limb Sounding

Experiment (SOLSE), Loop Heat Pump (LHP), and Sodium Sulfur Battery Experiment (NaSBE) were all shown during this video presentation. The launch of the STS-87 from different Kennedy Space Flight Center (KSFC) areas and Pre-flight training at the Johnson Space Center is presented. The retrieve and recovery spot satellite are also shown. Also, the landing of the Space Shuttle Columbia is presented from different areas at Kennedy Space Flight Center.

CASI

Flight Tests; Flight Training; Spacecrews; Spaceborne Experiments; Space Missions; Payloads; Launching; Landing

17

SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes space systems telemetry; space communications networks; astronavigation and guidance; and spacecraft radio blackout. For related information see also *04 Aircraft Communications and Navigation*; and *32 Communications and Radar*.

20030053380 Computer Sciences Corp., Lanham, MD, USA

Star Identification Using a Triplet Algorithm

Hashmall, Joseph A.; February 23, 2003; 1 pp.; In English; 54th International Astronautical Congress, 29 Sep. - 3 Oct. 2003, Bremen, Germany

Contract(s)/Grant(s): GS-35F-4381G; NASA Order S-71002-G; No Copyright; Avail: Other Sources; Abstract Only

The stars observed by onboard star trackers must be identified in order for the star tracker information to be used for attitude determination. Star identification associates the observed stars in the body frame with catalog stars, the positions of which in an inertial frame are well known. If the attitude is approximately known (from less accurate sensors) identification is relatively simple, but if there is no prior attitude knowledge (the Lost in Space problem) star identification is quite difficult. A new, reliable, and accurate star identification algorithm has been developed for use in a batch, ground-based attitude determination system. The identification algorithm uses input from one or more star trackers, each of which can observe three or more stars simultaneously. If observations are available at different times, rate data is used to relate them. The algorithm includes the following steps that are automatically performed: 1) Observations are examined to determine the optimal set of simultaneous star observations in a single tracker. 2) The selected optimal observations are identified using a triplet match. 3) The identified stars in the selected tracker at the selected time are used to compute an attitude at that time. 4) The rate data is refined by determination of biases that minimize the dispersion of repeated observations of the same stars. 5) The refined rate data is used to propagate the attitude to the times of each star observation. 6) The attitude at each time is used to associate all stars observed at that time, in each tracker, with catalog stars. The overall algorithm is very dependable at producing accurate star identification with no initial attitude input.

Author

Star Trackers; Algorithms; Attitude (Inclination); Identifying; Stars

20030054547 NASA Ames Research Center, Moffett Field, CA, USA

Computing, Information, and Communications Technology (CICT) Program Overview

VanDalsem, William R.; April 17, 2003; 47 pp.; In English; NASA Future Computing and Communications Technologies Course, 17 Apr. 2003, Moffett Field, CA, USA; Original contains black and white illustrations

Contract(s)/Grant(s): UPN 704-00-00; No Copyright; Avail: CASI; [A03](#), Hardcopy

The Computing, Information and Communications Technology (CICT) Program's goal is to enable NASA's Scientific Research, Space Exploration, and Aerospace Technology Missions with greater mission assurance, for less cost, with increased science return through the development and use of advanced computing, information and communication technologies

Derived from text

Information Systems; Space Exploration; Costs; Computers

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SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and spacecraft control and stability characteristics. For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance*; *39 Structural Mechanics*; and *16 Space Transportation and Safety*.

20030053180 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Performance of the Star Tracker Lightshades on the Earth Observing Satellite (EOS) Aqua

Kenney, Thomas; Schroeder, Michael; Donnelly, Michael; McNally, Mark; Bauer, Frank H., Technical Monitor; [2003]; 1 pp.;

In English; 2003 AAS Guidance and Control Conference, 5-9 Feb. 2003, Breckenridge, CO, USA; [2003]; Copyright; Avail: Other Sources; Abstract Only

The TRW built EOS Aqua spacecraft uses two Ball Aerospace CT-602 star trackers to provide attitude updates to the 3-axis, zero momentum, controller. Two months prior to the scheduled launch of Aqua, Ball reported an error in the design of the star tracker lightshades. The lightshades, which had been designed specifically for the EOS Common spacecraft, were not expected to meet the stray light rejection requirements of the mission and thus impact the overall spacecraft pointing performance. What ensued was an effort to characterize the actual performance of the existing shade design, determine what could be done within the physical envelope available, and modify the hardware to meet requirements. Changes were made based on this review activity and Aqua was launched on May 4, 2002. To date the spacecraft is meeting all of its science pointing requirements. Reported here are the lightshade design predictions, test results, and the measured on orbit performance of these shades.

Author

Star Trackers; Earth Observing System (Eos); Satellite Instruments; Satellite Attitude Control; Shades

20030053331 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Space and Atmospheric Environments: From Low Earth Orbits to Deep Space

Barth, Janet L.; [2003]; 19 pp.; In English; Sixth International Space Conference on Space Materials; Original contains color illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

Natural space and atmospheric environments pose a difficult challenge for designers of technological systems in space. The deleterious effects of environment interactions with the systems include degradation of materials, thermal changes, contamination, excitation, spacecraft glow, charging, radiation damage, and induced background interference. Design accommodations must be realistic with minimum impact on performance while maintaining a balance between cost and risk. The goal of applied research in space environments and effects is to limit environmental impacts at low cost relative to spacecraft cost and to infuse enabling and commercial off-the-shelf technologies into space programs. The need to perform applied research to understand the space environment in a practical sense and to develop methods to mitigate these environment effects is frequently underestimated by space agencies and industry. Applied science research in this area is critical because the complexity of spacecraft systems is increasing, and they are exposed simultaneously to a multitude of space environments.

Author

Aerospace Environments; Aerospace Systems; Spacecraft Design

20030053425 NASA Glenn Research Center, Cleveland, OH, USA

Research Needs in Fire Safety for the Human Exploration and Utilization of Space: Proceedings and Research Plan

Ruff, Gary A.; April 2003; 90 pp.; In English; Research Needs in Fire Safety for the Human Exploration and Utilization of Space: Proceedings and Research Plan, 25-26 Jun. 2001, Cleveland, OH, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 22-101-52-02

Report No.(s): NASA/CP-2003-212103; E-13759; NAS 1.55:212103; No Copyright; Avail: CASI; [A05](#), Hardcopy

The purpose of the workshop documented in this publication was to bring together personnel responsible for the design and operations of the International Space Station (ISS) and the fire protection research community to review the current knowledge in fire safety relative to spacecraft. From this review, research needs were identified that were then used to formulate a research plan with specific objectives. In this document, I have attempted to capture the very informative and lively discussions that occurred in the plenary sessions and the working groups. I hope that it will be useful to readers and serve as a significant step in assuring fire protection for the crews of current and future spacecraft.

Author

Conferences; International Space Station; Fire Prevention; Research And Development; Systems Engineering; Manned Space Flight; Aircraft Safety

20030054379 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Swift: A Gamma Ray Bursts Explorer

Gehrels, Neil; [2003]; 1 pp.; In English; Annual APS April Meeting 2003, Apr. 2003, USA; No Copyright; Avail: Other Sources; Abstract Only

Swift is a NASA gamma-ray burst MIDEX mission that is in development for launch in December 2003. It is a

multiwavelength transient observatory for GRB astronomy. The goals of the mission are to determine the origin of GRBs and their afterglows and use bursts to probe the early Universe. It will also perform a survey of the hard X-ray sky to a sensitivity level of -1 mCrab. A wide-field camera will detect more than a hundred GRBs per year to 5 times fainter than BATSE. Sensitive narrow-field X-ray and UV/optical telescopes will be pointed at the burst location in 20 to 70 sec by an autonomously controlled 'swift' spacecraft. For each burst, arcsec positions will be determined and optical/UV/X-ray/gamma-ray spectrophotometry performed. Measurements of redshift will be made for many of the bursts. The instrumentation is a combination of superb existing flight-spare hardware and design from XMM and Spectrum-X/JET-X contributed by collaborators in the UK and Italy and development of a coded-aperture camera with a large-area (approximately 0.5 square meter) CdZnTe detector array. The hardware is currently in final stages of fabrication and initial stages of integration and test. Key components of the mission are vigorous follow-up and outreach programs to engage the astronomical community and public in Swift.

Author

Astronomical Observatories; Gamma Ray Bursts; Gamma Ray Astronomy; Satellite Instruments; Gamma Ray Telescopes

20030054504 NASA Ames Research Center, Moffett Field, CA, USA

The Kepler Mission: A Search for Terrestrial Planets - Development Status

Koch, David; Borucki, W.; Mayer, D.; Caldwell, D.; Jenkins, J.; Dunham, E.; Geary, J.; Bachtell, E.; Deining, W.; Philbrick, R., et al.; April 02, 2003; 1 pp.; In English; 54th Space Exploration Symposium, 29 Sep. - 3 Oct. 2003, Bremen, Germany
Contract(s)/Grant(s): UPN 853-15-01; No Copyright; Avail: Other Sources; Abstract Only

We have embarked on a mission to detect terrestrial planets. The space mission has been optimized to search for earth-size planets (0.5 to 10 earth masses) in the habitable zone (HZ) of solar-like stars. Given this design, the mission will necessarily be capable of not only detecting Earth analogs, but a wide range of planetary types and characteristics ranging from Mercury-size objects with orbital periods of days to gas-giants in decade long orbits that have undeniable signatures even with only one transit detected. The mission is designed to survey the full range of spectral-type dwarf stars. The approach is to detect the periodic signal of transiting planets. Three or more transits of a star exceeding a combined threshold of eight sigma with a statistically consistent period, brightness change and duration provide a rigorous method of detection. From the relative brightness change the planet size can be calculated. From the period the orbital size can be calculated and its location relative to the HZ determined. Presented here are: the mission goals, the top level system design requirements derived from these goals that drive the flight system design, a number of the trades that have lead to the mission concept, expected photometric performance dependence on stellar brightness and spectral type based on the system 'noise tree' analysis. Updated estimates are presented of the numbers of detectable planets versus size, orbit, stellar spectral type and distances based on a planet frequency hypothesis. The current project schedule and organization are given.

Author

Planet Detection; Extrasolar Planets; Spacecraft Design; Flight Management Systems; Design Analysis; Space Missions

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SPACECRAFT INSTRUMENTATION AND ASTRIONICS

Includes the design, manufacture, or use of devices for the purpose of measuring, detecting, controlling, computing, recording, or processing data related to the operation of space vehicles or platforms. For related information see also *06 Avionics and Aircraft Instrumentation*; for spaceborne instruments not integral to the vehicle itself see *35 Instrumentation and Photography*; for spaceborne telescopes and other astronomical instruments see *89 Astronomy*.

20030054392 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Testing of Gyroless Estimation Algorithms for the FUSE Spacecraft

Thienel, Julie; Harman, Rick; Oshman, Yaakov; [2003]; 1 pp.; In English; AAs Guidance and Control Conference, 5-9 Feb. 2003, Breckenridge, CO, USA; Copyright; Avail: Other Sources; Abstract Only

The Far Ultraviolet Spectroscopic Explorer (FUSE) is equipped with two ring laser gyros on each of the spacecraft body axes. In May 2001 one gyro failed. It is anticipated that all of the remaining gyros will also fail, based on intensity warnings. In addition to the gyro failure, two of four reaction wheels failed in late 2001. The spacecraft control, now relies heavily on magnetic torque to perform the necessary science maneuvers. The only sensor available during slews is a magnetometer. This paper documents the testing and development of gyroless attitude and rate estimation algorithms for FUSE. The results of two approaches are presented, one relies on a kinematics model for propagation, a method used in aircraft tracking, and the other is a traditional Extended Kalman filter that utilizes Euler's equations in the propagation of the estimated rate. Finally, the

question of closed-loop stability is addressed. The ability of the controller to meet the science slew requirements, without the gyros, is tested through simulations.

Author

Algorithms; Applications Programs (Computers); Computerized Simulation; Spacecraft Control; Torque; Far Uv Spectroscopic Explorer; Attitude Control; Estimating

20030055150 NASA Kennedy Space Center, Cocoa Beach, FL, USA

STS-109/Columbia/HST Pre-Launch Activities/Launch On Orbit-Landing-Crew Egress

March 12, 2002; In English; No Copyright; Avail: CASI; [V03](#), Videotape-VHS; [B03](#), Videotape-Beta

The STS-109 Space Shuttle Mission begins with introduction of the seven crew members: Commander Scott D. Altman, pilot Duane G. Carey, payload commander John M. Grunsfeld, mission specialists: Nancy J. Currie, James H. Newman, Richard M. Linnehan, and Michael J. Massimino. Spacewalking NASA astronauts revive the Hubble Space Telescope's (HST) sightless infrared eyes, outfitting the observatory with an experimental refrigerator designed to resuscitate a comatose camera. During this video presentation John Grunsfeld and Rick Linnehan bolt the new cryogenic cooler inside HST and hung a huge radiator outside the observatory and replaces the telescope power switching station. In the video we can see how the shuttle robot arm operator, Nancy Currie, releases the 13-ton HST. Also, the landing of the Space Shuttle Columbia is presented.

CASI

Hubble Space Telescope; Maintenance; Cryogenic Cooling; Infrared Radiation; Cameras; Switching; Refrigerators

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SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information see also *07 Aircraft Propulsion and Power*, *28 Propellants and Fuels*, *15 Launch Vehicles and Launch Operations*, and *44 Energy Production and Conversion*.

20030053201 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Recent GSFC Space Power Systems Flight Experience

Enciso, Marlon L.; Ahmad, Anisa; [2003]; 26 pp.; In English; Space Power Workshop, 21-24 Apr. 2003; Original contains color illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

This viewgraph presentation provides information on the power supplies on scientific satellites, including batteries, and power supply anomalies during in-flight operations. The recent Goddard Space Flight Center (GSFC) missions profiled include the Tropical Rainfall Measuring Mission (TRMM), Landsat 7, Terra-EOS AM, Earth Observing Mission (EO1), Microwave Anisotropy Probe (MAP), AQUA-EOS PM, and the Ice, Cloud and Land Elevation Satellite (ICESAT).

Author

Spacecraft Power Supplies; Electric Batteries; Anomalies

20030053202 NASA Glenn Research Center, Cleveland, OH, USA

Reduced Toxicity Fuel Satellite Propulsion System Including Plasmatron

Schneider, Steven J., Inventor; April 15, 2003; 29 pp.; In English; Original contains black and white illustrations

Patent Info.: Filed 17 Apr. 2001; No Copyright; Avail: CASI; [A03](#), Hardcopy

A reduced toxicity fuel satellite propulsion system including a reduced toxicity propellant supply for consumption in an axial class thruster and an ACS class thruster. The system includes suitable valves and conduits for supplying the reduced toxicity propellant to the ACS decomposing element of an ACS thruster. The ACS decomposing element is operative to decompose the reduced toxicity propellant into hot propulsive gases. In addition the system includes suitable valves and conduits for supplying the reduced toxicity propellant to an axial decomposing element of the axial thruster. The axial decomposing element is operative to decompose the reduced toxicity propellant into hot gases. The system further includes suitable valves and conduits for supplying a second propellant to a combustion chamber of the axial thruster. whereby the hot gases and the second propellant auto-ignite and begin the combustion process for producing thrust.

Author

Spacecraft Propulsion; Toxicity; Fuel Systems; Artificial Satellites; Plasmatrons

20030054539 NASA Marshall Space Flight Center, Huntsville, AL, USA

Advanced Space Propulsion: A Research Perspective

Litchford, Ron; Cole, John; Rodgers, Steve; Sackheim, Bob; [2002]; 16 pp.; In English; The Propulsion Engineering Research Center (PERC) 14th Annual Symposium on Propulsion, 10-11 Dec. 2002, State College, PA, USA; Original contains color and black and white illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

This viewgraph presentation provides information on spacecraft propulsion research. The organizational and management principals needed for the research are stated. The presentation recommends a space propulsion research program. It also states some of the factors which drive research in the field, as well as the desired goals, objectives, and focus of the research.

CASI

Spacecraft Propulsion; Management Planning; Research Management; Research

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COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

20030053353 NASA Langley Research Center, Hampton, VA, USA

Dry Process for Manufacturing Hybridized Boron Fiber/Carbon Fiber Thermoplastic Composite Materials from a Solution Coated Precursor

Belvin, Harry L., Inventor; Cano, Roberto J., Inventor; February 04, 2003; 13 pp.; In English

Patent Info.: Filed 8 Jun. 2000; US-Patent-6,514,370; US-Patent-Appl-SN-591384; NASA-Case-LAR-15852-1; No Copyright; Avail: CASI; [A03](#), Hardcopy

An apparatus for producing a hybrid boron reinforced polymer matrix composite from precursor tape and a linear array of boron fibers. The boron fibers are applied onto the precursor tapes and the precursor tape processed within a processing component having an impregnation bar assembly. After passing through variable-dimension forming nip-rollers, the precursor tape with the boron fibers becomes a hybrid boron reinforced polymer matrix composite. A driving mechanism is used to pulled the precursor tape through the method and a take-up spool is used to collect the formed hybrid boron reinforced polymer matrix composite.

Official Gazette of the U.S. Patent and Trademark Office

Boron Reinforced Materials; Boron Fibers; Fiber Composites; Polymer Matrix Composites; Fabrication

20030053357 NASA Langley Research Center, Hampton, VA, USA

Process of Making Boron-Fiber Reinforced Composite Tape

Belvin, Harry L., Inventor; Cano, Roberto J., Inventor; Johnston, Norman J., Inventor; Marchello, Joseph M., Inventor; December 31, 2002; 16 pp.; In English; Original contains black and white illustrations

Patent Info.: Filed 18 Jul. 2000; US-Patent-6,500,370; US-Patent-Appl-SN-620274; NASA-Case-LAR-15470-1-CU; No Copyright; Avail: CASI; [A03](#), Hardcopy

The invention is an apparatus and method for producing a hybrid boron reinforced polymer matrix composition from powder pre-impregnated fiber tow bundles and a linear array of boron fibers. The boron fibers are applied onto the powder pre-impregnated fiber tow bundles and then are processed within a processing component having an impregnation bar assembly. After passing through variable-dimension forming nip-rollers, the powder pre-impregnated fiber tow bundles with the boron fibers become a hybrid boron reinforced polymer matrix composite tape. A driving mechanism pulls the powder pre-impregnated fiber tow bundles with boron fibers through the processing line of the apparatus and a take-up spool collects the formed hybrid boron-fiber reinforced polymer matrix composite tape.

Official Gazette of the U.S. Patent and Trademark Office

Boron Reinforced Materials; Boron Fibers; Ceramic Matrix Composites; Patents; Seals (Stoppers)

20030053424 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Outgassing Data for Selecting Spacecraft Materials

Campbell, William A., Jr.; Marriott, Richard S.; Park, John J.; June 1984; 280 pp.; In English

Report No.(s): NASA-RP-1124; Rept-84B0271; NAS 1.61:1124; No Copyright; Avail: CASI; [A13](#), Hardcopy

Outgassing data, derived from tests at 396 K (125 C) for 24 hours in vacuum as per ASTM E 595-77, have been compiled for numerous materials for spacecraft use. The data presented are the total mass loss (TML) and the collected volatile

condensable materials (CVCm). The various materials are compiled by likely usage and alphabetically.

Author

Outgassing; Spacecraft Construction Materials; Condensing; Data Processing

25

INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

Includes the analysis, synthesis, and use of inorganic and organic compounds; combustion theory; electrochemistry; and photochemistry. For related information see category *34 Fluid Dynamics and Thermodynamics*. For astrochemistry see category *90 Astrophysics*.

20030053400 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Comparison of a 2D Photochemical Model to Data Using Statistical Trend Analysis

Bhartia, P. K., Technical Monitor; Stolarski, Richard; Jackman, Charles; Fleming, Eric; Frith, Stacey Hollandsworth; [2002]; 1 pp.; In English; AMS, 4-7 Nov. 2002, San Antonio, TX, USA; No Copyright; Avail: Other Sources; Abstract Only

We have analyzed our 23-year merged ozone data set for variability and trends with a statistical time-series model. To assist in that analysis, we have analyzed the Goddard 2D photochemical model for the same time period with the same time-series model. Multiple runs of the photochemical model allow us to separate the effects of various terms on ozone, such as solar cycle and volcanic eruptions. We use this to help us separate those signals from each other in the data. We also used a smoothed version of the photochemical model's prediction of global ozone change in place of a simple linear trend. We find a number of interesting results. This particular photochemical model is more sensitive to chlorine perturbations than the atmosphere appears to be. It is less sensitive to solar cycle. It predicts an effect from the Pinatubo eruption that is nearly symmetric in the two hemispheres, but the data appears to have not responded to Pinatubo in the southern mid-latitudes. These results and their uncertainties will be discussed.

Author

Statistical Analysis; Trend Analysis; Two Dimensional Models; Variability; Time Series Analysis; Photochemical Reactions

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METALS AND METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals and metallic materials; and metallurgy.

20030053363 NASA Langley Research Center, Hampton, VA, USA

Surface Treatment

Park, Cheol, Inventor; Lowther, Sharon E., Inventor; St.Clair, Terry L., Inventor; February 18, 2003; 22 pp.; In English Patent Info.: Filed 9 Feb. 2001; No Copyright; Avail: CASI; [A03](#), Hardcopy

A simple surface treatment process is provided which offers a high performance surface for a variety of applications at low cost. This novel surface treatment, which is particularly useful for Ti-6Al-4V alloys, is achieved by forming oxides on the surface with a two-step chemical process and without mechanical abrasion. First, after solvent degreasing, sulfuric acid is used to generate a fresh titanium surface. Next, an alkaline perborate solution is used to form an oxide on the surface. This acid-followed-by-base treatment is cost effective and relatively safe to use in commercial applications. In addition, it is chromium-free, and has been successfully used with a sol-gel coating to afford a strong adhesive bond that exhibits excellent durability after the bonded specimens have been subjected to a harsh 72 hour water boil immersion. Phenylethynyl containing adhesives were used to evaluate this surface treatment with a novel coupling agent containing both trialkoxysilane and phenylethynyl groups. 8 Claims, 16 Drawing Sheets

Official Gazette of the U.S. Patent and Trademark Office

Surface Treatment; Adhesives; Aluminum Alloys; Chemical Reactions; Chromium; Titanium Alloys; Vanadium Alloys

NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see *24 Composite Materials*.

20030053395 NASA Marshall Space Flight Center, Huntsville, AL, USA

Flightweight Carbon Nanotube Magnet Technology

Chapman, J. N.; Schmidt, H. J.; Ruoff, R. S.; Chandrasekhar, V.; Dikin, D. A.; Litchford, R. J.; March 2003; 46 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NAS8-01181

Report No.(s): NASA/TP-2003-212342; M-1070; NAS 1.60:212342; Copyright; Avail: CASI; [A03](#), Hardcopy

Virtually all plasma-based systems for advanced airborne/spaceborne propulsion and power depend upon the future availability of flightweight magnet technology. Unfortunately, current technology for resistive and superconducting magnets yields system weights that tend to counteract the performance advantages normally associated with advanced plasma-based concepts. The ongoing nanotechnology revolution and the continuing development of carbon nanotubes (CNT), however, may ultimately relieve this limitation in the near future. Projections based on recent research indicate that CNTs may achieve current densities at least three orders of magnitude larger than known superconductors and mechanical strength two orders of magnitude larger than steel. In fact, some published work suggests that CNTs are superconductors. Such attributes imply a dramatic increase in magnet performance-to-weight ratio and offer real hope for the construction of true flightweight magnets. This Technical Publication reviews the technology status of CNTs with respect to potential magnet applications and discusses potential techniques for using CNT wires and ropes as a winding material and as an integral component of the containment structure. The technology shortfalls are identified and a research and technology strategy is described that addresses the following major issues: (1) Investigation and verification of mechanical and electrical properties, (2) development of tools for manipulation and fabrication on the nanoscale, (3) continuum/molecular dynamics analysis of nanotube behavior when exposed to practical bending and twisting loads, and (4) exploration of innovative magnet fabrication techniques that exploit the natural attributes of CNTs.

Author

Carbon Nanotubes; Nanotechnology; Technology Assessment; Nanofabrication; Magnetic Properties

PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels. For nuclear fuels see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power*; *20 Spacecraft Propulsion and Power*; and *44 Energy Production and Conversion*.

20030054522 NASA Ames Research Center, Moffett Field, CA, USA

Ames Hybrid Combustion Facility

Zilliac, Greg; Karabeyoglu, Mustafa A.; Cantwell, Brian; Hunt, Rusty; DeZilwa, Shane; Shoffstall, Mike; Soderman, Paul T.; Bencze, Daniel P., Technical Monitor; February 2003; 151 pp.; In English

Contract(s)/Grant(s): NCC2-1300; 714-04-00

Report No.(s): NASA/TM-2003-211864; NAS 1.15:211864; A-0309067; Copyright; Avail: CASI; [A08](#), Hardcopy

The report summarizes the design, fabrication, safety features, environmental impact, and operation of the Ames Hybrid-Fuel Combustion Facility (HCF). The facility is used in conducting research into the scalability and combustion processes of advanced paraffin-based hybrid fuels for the purpose of assessing their applicability to practical rocket systems. The facility was designed to deliver gaseous oxygen at rates between 0.5 and 16.0 kg/sec to a combustion chamber operating at pressures ranging from 300 to 900. The required run times were of the order of 10 to 20 sec. The facility proved to be robust and reliable and has been used to generate a database of regression-rate measurements of paraffin at oxygen mass flux levels comparable to those of moderate-sized hybrid rocket motors.

Author

Research Facilities; Combustion Chambers; Hybrid Propellant Rocket Engines; Structural Design; Design Analysis; Fabrication; Safety Factors; Combustion Physics

29 SPACE PROCESSING

Includes space-based development of materials, compounds, and processes for research or commercial application. Also includes the development of materials and compounds in simulated reduced-gravity environments. For legal aspects of space commercialization see *84 Law, Political Science and Space Policy*.

20030053200 Clarkson Univ., Potsdam, NY, USA

Detached Solidification in Microgravity: A Review

Regel, Liya L.; Wilcox, William R., Hanser; Microgravity: Science and Technology; 1998; Volume 11, No. 4, pp. 152-166; In English

Contract(s)/Grant(s): NAG8-1482; Copyright; Avail: Other Sources

Directional solidification in microgravity has often led to ingots that grew with little or no contact with the ampoule wall. When this occurred, crystallographic perfection was usually greatly improved-often by several orders of magnitude. We summarize here the experiments that have produced such results. Mechanisms for detached solidification will be reviewed in a subsequent paper.

Author

Directional Solidification (Crystals); Microgravity; Detachment

20030053430 NASA Kennedy Space Center, Cocoa Beach, FL, USA

An Introduction to Mars ISPP Technologies

Lueck, Dale E.; Research Needs in Fire Safety for the Human Exploration and Utilization of Space: Proceedings and Research Plan; April 2003, pp. 65-77; In English; See also 20030053425; Original contains black and white illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

This viewgraph presentation provides information on potential In Situ Propellant Production (ISPP) technologies for Mars. The presentation discusses Sabatier reactors, water electrolysis, the advantages of methane fuel, oxygen production, PEM cell electrolyzers, zirconia solid electrolyte cells, reverse water gas shift (RWGS), molten carbonate electrolysis, liquid CO₂, and ionic liquids.

CASI

In Situ Resource Utilization; Oxygen Production; Hydrocarbon Fuel Production; Hydrogen Production; Methane; Mars (Planet); Water Splitting; Electrolysis

31 ENGINEERING (GENERAL)

Includes general research topics related to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention. For specific topics in engineering see *categories 32 through 39*.

20030053427 NASA Johnson Space Center, Houston, TX, USA

Spacecraft Fire Safety: A Human Space Flight Program Perspective

Pedley, Michael D.; Research Needs in Fire Safety for the Human Exploration and Utilization of Space: Proceedings and Research Plan; April 2003, pp. 27-33; In English; See also 20030053425; Original contains color illustrations; No Copyright; Avail: CASI; [A02](#), Hardcopy

This paper presents viewgraphs on the International Space Station's fire safety program from a human space flight perspective. The topics include: 1) Typical Manned Spacecraft Materials; 2) Typical Flammable Hardware Protection; 3) Materials Flammability; 4) Fire Retardants; 5) Nonflammable Foam Cushion Material; 6) Electrical Wire and Cable; 7) Russian Solid-Fuel Oxygen Generator (SFOG); 8) GOX Ignition Mechanisms; 9) Fire Detection; and 10) Fire Suppression.

CASI

Fire Prevention; International Space Station; Manned Space Flight; Manned Spacecraft

20030053429 NASA Johnson Space Center, Houston, TX, USA

Overview of ISS U.S. Fire Detection and Suppression System

Whitaker, Alana; Research Needs in Fire Safety for the Human Exploration and Utilization of Space: Proceedings and Research Plan; April 2003, pp. 49-63; In English; See also 20030053425; Original contains color illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

This paper presents a general overview of the International Space Station's Fire Detection and Suppression System. The topics include: 1) Introduction to Fire Detection and Suppression (FDS); 2) Description of (FDS) Subsystems; 3) FDS System Component Location and Status; 4) FDS System Capabilities; 5) FDS Automatic and Manual Response; 6) Post Fire Atmosphere Restoration and Air Quality Assessment; and 7) FDS Research Needs. This paper is in viewgraph form.
CASI

Fire Fighting; General Overviews; International Space Station; Systems Engineering

32

COMMUNICATIONS AND RADAR

Includes radar; radio, wire, and optical communications; land and global communications; communications theory. For related information see also 04 Aircraft Communications and Navigation; and 17 *Space Communications, Spacecraft Communications, Command and Tracking*; for search and rescue, see 03 *Air Transportation and Safety*; and 16 *Space Transportation and Safety*.

20030053342 NASA Marshall Space Flight Center, Huntsville, AL, USA

Method and Apparatus for Reading Two Dimensional Identification Symbols Using Radar Techniques

Schramm, Harry F., Jr., Inventor; Roxby, Donald L., Inventor; March 04, 2003; 6 pp.; In English

Patent Info.: Filed 16 Mar. 2000; US-Patent-6,529,154; US-Patent-Appl-SN-528795; NASA-Case-MFS-31230-1; No Copyright; Avail: CASI; [A02](#), Hardcopy

A method and apparatus are provided for sensing two-dimensional identification marks provided on a substrate or embedded within a substrate below a surface of the substrate. Micropower impulse radar is used to transmit a high risetime, short duration pulse to a focussed radar target area of the substrate having the two dimensional identification marks. The method further includes the steps of listening for radar echoes returned from the identification marks during a short listening period window occurring a predetermined time after transmission of the radar pulse. If radar echoes are detected, an image processing step is carried out. If no radar echoes are detected, the method further includes sequentially transmitting further high risetime, short duration pulses, and listening for radar echoes from each of said further pulses after different elapsed times for each of the further pulses until radar echoes are detected. When radar echoes are detected, data based on the detected echoes is processed to produce an image of the identification marks.

Author

Patents; Radar Echoes; Pulse Radar; Image Processing; Substrates

20030053377 NASA Marshall Space Flight Center, Huntsville, AL, USA

Infrared Communication System

Dewberry, Brandon Scott, Inventor; Varnavas, Kosta A., Inventor; January 14, 2003; 7 pp.; In English

Patent Info.: Filed 16 Jun. 1999; US-Patent-6,507,425; US-Patent-Appl-SN-334412; NASA-Case-MFS-31331-1; No Copyright; Avail: CASI; [A02](#), Hardcopy

An infrared communication system includes a reconfigurable RAM-based programmable logic device (PLD), an EPROM to provide configuration instructions to the PLD, and a clock supplying a clock signal to the PLD. A data input device and infrared transceiver are coupled to the PLD. The configured PLD uses the clock signal to synchronize data transfer between the data input device and the infrared transceiver.

Official Gazette of the U.S. Patent and Trademark Office

Infrared Instruments; Communication

20030054357 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Nonaxisymmetric Variations Deep in the Convection Zone

Duvall, Thomas; [2002]; 1 pp.; In English; SOH0 12/GONG+ 2002, 27 Oct. - 1 Nov. 2002, Big Bear Lake, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

Using a deep-focusing time-distance technique and the MDI medium-1 data, a preliminary study of nonaxisymmetric variability deep in the convection zone has been performed. The purpose of the present study is to see what signals might be present in raw travel times indicating variation. To this end, noise levels will be examined. Correlations with point separations in the range 40-50 deg. have been measured for the entire medium-1 dataset over a significant fraction of the solar disk. Both

flows and mean-time variations have been examined. Separation of near-surface signals from deep signals will also be examined.

Author

Noise Intensity; Convection; Variations; Signal Processing

20030054398 NASA Goddard Space Flight Center, Greenbelt, MD, USA

RFI at L-band in Synthetic Aperture Radiometers

LeVine, David M.; Haken, M.; Wang, James R., Technical Monitor; [2003]; 1 pp.; In English; IGARSS Conference, 21-25 Jul. 2003, Toulouse, France; No Copyright; Avail: Other Sources; Abstract Only

The spectral window at 1.413 GHz (L-band), set aside for passive use only, is critical for passive remote sensing of the earth from space. It is the largest spectral window available in the long wavelength end of the microwave spectrum where measurements are needed to monitor parameters of the surface such as soil moisture and sea surface salinity. The sensitivity to these parameters is rapidly lost at higher frequencies and is compromised by the ionosphere and antenna size at lower frequencies. Instruments for remote sensing from space in this spectral window are being developed by NASA (Aquarius) and ESA (SMOS) and are expected to be in orbit in a few years (2006). Although the band at 1.413 GHz is protected for passive use, RFI is a common problem. For example, the synthetic aperture radiometer, ESTAR (L-band, Horizontal polarization), has frequently experienced problems with RFI. During the Southern Great Plains Experiments (1997 and 1999), ESTAR experienced RFI significant enough to warrant changes in flight lines. The largest sources of RFI were identified as originating in airports and a likely source is air traffic control radar. In experiments in the vicinity of Richmond, VA, RFI in the form of periodic spikes was recorded, again suggestive of radar. However, in most cases the sources of the RFI are unknown. RFI is a sufficiently common problem that the first step in processing ESTAR data is a screening for RFI (a filter is used to detect large, rapid changes in brightness). Recently, measurements have been made with a new synthetic aperture radiometer, 2D-STAR. Examples of RFI observed simultaneously with ESTAR and the new synthetic aperture radiometer will be presented. 2D-STAR is an airborne instrument designed to develop the technology of aperture synthesis in two dimensions. It employs dual polarized patch antennas arranged in a cross configuration (+). Synthesis in two dimensions offers the potential for optimal thinning, but because of the wide field of view of the individual antennas it is potentially more susceptible to RFI. The 2D-STAR instrument was flown together with ESTAR in a series of test flights on the NASA P-3 aircraft near the Wallops Flight Facility during the summer of 2002. Both instruments experienced RFI over common locations. Examples will be presented and a comparison between instruments presented.

Author

Synthetic Apertures; Radiometers; Remote Sensing; Earth Observations (From Space); Airborne Equipment

33

ELECTRONICS AND ELECTRICAL ENGINEERING

Includes development, performance, and maintainability of electrical/electronic devices and components; related test equipment; and microelectronics and integrated circuitry. for related information see also *60 Computer Operations and Hardware*; and *76 Solid-State Physics*. For communications equipment and devices see *32 Communications and Radar*.

20030053179 ManTech Advanced Systems International, Greenbelt, MD, USA

Potential Damage to Flight Hardware from MIL-STD-462 CS02 Setup

Harris, Patrick K.; Block, Nathan F.; [2003]; 4 pp.; In English; 2003 IEEE Symposium on Electromagnetic Compatibility, 18 Aug. 2003, Boston, MA, USA

Contract(s)/Grant(s): NAS5-02034; NAS5-32537; No Copyright; Avail: CASI; [A01](#), Hardcopy

The MIL-STD-462 CS02 conducted susceptibility test setup includes an audio transformer, with the secondary used as an inductor, and a large capacitor. Together, these two components form an L-type low-pass filter to minimize the injected test signal input into the power source. Some flight hardware power input configurations are not compatible with this setup and break into oscillation when powered up. This, in turn, can damage flight hardware. Such an oscillation resulted in the catastrophic failure of an item tested in the Goddard Space Flight Center (GSFC) Large electromagnetic compatibility (EMC) Test Facility.

Author

Damage; Hardware; Transformers; Audio Equipment; Inductors; Capacitors

20030053337 NASA Langley Research Center, Hampton, VA, USA

Polymer-Polymer Bilayer Actuator

Su, Ji, Inventor; Harrison, Joycelyn S., Inventor; St.Clair, Terry L., Inventor; April 08, 2003; 7 pp.; In English
Patent Info.: Filed 23 Oct. 2000; No Copyright; Avail: CASI; [A02](#), Hardcopy

A device for providing an electromechanical response includes two polymeric webs bonded to each other along their lengths. At least one polymeric web is activated upon application thereto of an electric field and exhibits electrostriction by rotation of polar graft moieties within the polymeric web. In one embodiment, one of the two polymeric webs in an active web upon application thereto of the electric field, and the other polymeric web is a non-active web upon application thereto of the electric field. In another embodiment, both of the two polymeric webs are capable of being active webs upon application thereto of the electric field. However, these two polymeric webs are alternately activated and non-activated by the electric field.

Author

Polymers; Actuators; Electromechanical Devices

20030053364 NASA Pasadena Office, CA, USA

Evolutionary Technique for Automated Synthesis of Electronic Circuits

Stoica, Adrian, Inventor; Salazar-Lazaro, Carlos Harold, Inventor; February 25, 2003; 12 pp.; In English
Patent Info.: Filed 7 Jun. 2000; No Copyright; Avail: CASI; [A03](#), Hardcopy

A method for evolving a circuit comprising configuring a plurality of transistors using a plurality of reconfigurable switches so that each of the plurality of transistors has a terminal coupled to a terminal of another of the plurality of transistors that is controllable by a single reconfigurable switch. The plurality of reconfigurable switches being controlled in response to a chromosome pattern. The plurality of reconfigurable switches may be controlled using an annealing function. As such, the plurality of reconfigurable switches may be controlled by selecting qualitative values for the plurality of reconfigurable switches in response to the chromosomal pattern, selecting initial quantitative values for the selected qualitative values, and morphing the initial quantitative values. Typically, subsequent quantitative values will be selected more divergent than the initial quantitative values. The morphing process may continue to partially or to completely polarize the quantitative values.

Author

Evolvable Hardware; Synthesis; Circuits

20030053436 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Cryogenically Cooled Field Effect Transistors for Low-Noise Systems

Wollack, Edward J.; [2002]; 1 pp.; In English; Applied Superconductivity and Cryogenics Microwave Subsystems Workshop, 3-4 Aug. 2002, Houston, TX, USA; No Copyright; Avail: Other Sources; Abstract Only

Recent trends in the design, fabrication and use of High-Electron-Mobility-Transistors (HEMT) in low noise amplifiers are reviewed. Systems employing these devices have achieved the lowest system noise for wavelengths greater than three millimeters with relatively modest cryogenic cooling requirements in a variety of ground and space based applications. System requirements which arise in employing such devices in imaging applications are contrasted with other leading coherent detector candidates at microwave wavelengths. Fundamental and practical limitations which arise in the context of microwave application of field effect devices at cryogenic temperatures will be discussed from a component and systems point of view.

Author

Cryogenic Cooling; Field Effect Transistors; Low Noise; High Electron Mobility Transistors; Amplifiers

20030054512 Computer Sciences Corp., USA, NASA Ames Research Center, Moffett Field, CA, USA

Role of Scattering in Nanotransistors

Anantram, M. P.; Svizhenko, Alexei; April 08, 2003; 11 pp.; In English; 9th International Workshop on Computational Electronics, 25-29 May 2003, Rome, Italy

Contract(s)/Grant(s): NAS2-14303; RTOP 519-40-12; No Copyright; Avail: CASI; [A03](#), Hardcopy

This viewgraph presentation provides information on scattering and series resistance in nanotransistors with specific characteristics. The presentation includes diagrams of nanotransistor channels, and discusses scattering mechanisms.

Author

Nanostructures (Devices); Transistors; Scattering; Electrical Resistance

FLUID MECHANICS AND THERMODYNAMICS

Includes fluid dynamics and kinematics and all forms of heat transfer; boundary layer flow; hydrodynamics; hydraulics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics*.

20030053454 NASA Glenn Research Center, Cleveland, OH, USA

Fan Beam Emission Tomography for Estimating Scalar Properties in Laminar Flames

Lim, Jongmook; Sivathanu, Yudaya; Feikema, Douglas; April 2003; 11 pp.; In English; Third Joint Meeting of the U.S. Sections of the Combustion Institute, 16-19 Mar. 2003, Chicago, IL, USA; Original contains black and white illustrations
Contract(s)/Grant(s): WBS 22-101-12-17

Report No.(s): NASA/TM-2003-212302; NAS 1.15:212302; E-13873; No Copyright; Avail: CASI

A new method of estimating temperatures and gas species concentrations (CO₂ and H₂O) in a laminar flame is reported. The path-integrated, spectral radiation intensities emitted from a laminar flame at multiple wavelengths and view angles are calculated using a narrow band radiation model. Synthetic data, in the form of radial profiles of temperature and gas concentrations, are used in these calculations. The calculations mimic measurements that would theoretically be obtained using a mid-infrared spectrometer with a scanner. The path integrated spectral radiation intensities are deconvoluted using a maximum likelihood estimation method in conjunction with an iterative scheme. The deconvolution algorithm accounts for the self-absorption of radiation by the intervening gases, and provides the local temperature and gas species concentrations. The deconvoluted temperatures and gas concentrations are compared with the synthetic data used for calculating the spectral radiation intensities. The deconvoluted temperatures and gas species concentrations are within 0.5 % of the synthetic data. The deconvolution algorithm is expected to provide combustion researchers with an easy method of obtaining the radial profiles of major gas species concentrations and temperatures in laminar flames non-intrusively using a mid-infrared spectrometer with a scanner.

Author

Flame Spectroscopy; Flames; Tomography; Spectroscopic Analysis; Gas Composition; Emission Spectra; Combustion; Gas Temperature

20030054506 NASA Ames Research Center, Moffett Field, CA, USA

Successes and Challenges of Incompressible Flow Simulation

Kwak, Dochan; Kiris, Cetin; [2003]; 12 pp.; In English; 16th AIAA Computational Fluid Dynamics Conference, 23-26 Jun. 2003, Orlando, FL, USA; No Copyright; Avail: CASI; [A03](#), Hardcopy

During the past thirty years, numerical methods and simulation tools for incompressible flows have been advanced as a subset of CFD discipline. Even though incompressible flows are encountered in many areas of engineering, simulation of compressible flow has been the major driver for developing computational algorithms and tools. This is probably due to rather stringent requirements for predicting aerodynamic performance characteristics of flight vehicles, while flow devices involving low speed or incompressible flow could be reasonably well designed without resorting to accurate numerical simulations. As flow devices are required to be more sophisticated and highly efficient, CFD tools become indispensable in fluid engineering for incompressible and low speed flow. This paper is intended to review some of the successes made possible by advances in computational technologies during the same period, and discuss some of the current challenges.

Author

Compressible Flow; Incompressible Flow; Computerized Simulation; Algorithms

INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography. For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Avionics and Aircraft Instrumentation*; and *19 Spacecraft Instrumentation and Astrionics*.

20030053159 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Solar Imaging UV/EUV Spectrometers Using TVLS Gratings

Thomas, Roger J.; [2003]; 1 pp.; In English; 34th Meeting of the AAS Solar Physics Division, 16-20 Jun. 2003, Laurel, MD, USA; No Copyright; Avail: Other Sources; Abstract Only

It is a particular challenge to develop a stigmatic spectrograph for UV, EUV wavelengths since the very low

normal-incidence reflectance of standard materials most often requires that the design be restricted to a single optical element which must simultaneously provide both reimaging and spectral dispersion. This problem has been solved in the past by the use of toroidal gratings with uniform line-spaced rulings (TULS). A number of solar extreme ultraviolet (EUV) spectrometers have been based on such designs, including SOHO/CDS, Solar-B/EIS, and the sounding rockets Solar Extreme ultraviolet Research Telescope and Spectrograph (SERTS) and Extreme Ultraviolet Normal Incidence Spectrograph (EUNIS). More recently, Kita, Harada, and collaborators have developed the theory of spherical gratings with varied line-space rulings (SVLS) operated at unity magnification, which have been flown on several astronomical satellite missions. We now combine these ideas into a spectrometer concept that puts varied-line space rulings onto toroidal gratings. Such TVLS designs are found to provide excellent imaging even at very large spectrograph magnifications and beam-speeds, permitting extremely high-quality performance in remarkably compact instrument packages. Optical characteristics of three new solar spectrometers based on this concept are described: SUMI and RAISE, two sounding rocket payloads, and NEXUS, currently being proposed as a Small-Explorer (SMEX) mission.

Author

Solar Spectrometers; Ultraviolet Spectrometers; Extreme Ultraviolet Radiation; Gratings (Spectra)

20030053366 NASA, Washington, DC, USA

Cable and Line Inspection Mechanism

Ross, Terence J., Inventor; January 28, 2003; 11 pp.; In English

Patent Info.: Filed 9 Feb. 1999; US-Patent-6,512,536 B1

Report No.(s): US-Patent-6,512,536; US-Patent-Appl-SN-09-257-135; No Copyright; Avail: CASI; [A03](#), Hardcopy

An automated cable and line inspection mechanism visually scans the entire surface of a cable as the mechanism travels along the cable's length. The mechanism includes a drive system, a video camera, a mirror assembly for providing the camera with a 360 degree view of the cable, and a laser micrometer for measuring the cable's diameter. The drive system includes an electric motor and a plurality of drive wheels and tension wheels for engaging the cable or line to be inspected, and driving the mechanism along the cable. The mirror assembly includes mirrors that are positioned to project multiple images of the cable on the camera lens, each of which is of a different portion of the cable. A data transceiver and a video transmitter are preferably employed for transmission of video images, data and commands between the mechanism and a remote control station.

Author

Inspection; Lasers; Remote Control; Scanners; Video Data; Cables (Ropes)

20030053415 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Symmetric Waveguide Orthomode Junctions

Wollack, E. J.; Grammer, W.; [2003]; 1 pp.; In English; 14th International TeraHertz Conference, 21-24 Apr. 2003, Tucson, AZ, USA; No Copyright; Avail: Other Sources; Abstract Only

Imaging applications at millimeter and submillimeter wavelengths demand precise characterization of the amplitude, spectrum, and polarization of the electromagnetic radiation. The use of a waveguide orthomode transducer (OMT) can help achieve these goals by increasing spectral coverage and sensitivity while reducing exit aperture size, optical spill, instrumental polarization offsets, and lending itself to integration in focal plane arrays. For these reasons, four-fold symmetric OMTs are favored over a traditional quasi-optical wire grid for focal plane imaging arrays from a systems perspective. The design, fabrication, and test of OMTs realized with conventional split-block techniques for millimeter wave-bands are described. The design provides a return loss is -20 dB over a full waveguide band (40% bandwidth), and the cross-polarization and isolation are greater than -40 dB for tolerances readily achievable in practice. Prototype examples realized in WR10.0 and WR3.7 wavebands will be considered in detail.

Author

Symmetry; Waveguides; Transducers; Polarization (Waves); Imaging Techniques

20030053437 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Initial Operation and Calibration of the SOLIS Vector Spectromagnetograph

Jones, H. P.; Harvey, J. W.; Henney, C. J.; Keller, C. U.; [2003]; 1 pp.; In English; SHINE 2003 Workshop, 6-11 Jul. 2003, Wailea, HI, USA; No Copyright; Avail: Other Sources; Abstract Only

The National Solar Observatory's SOLIS Vector Spectromagnetograph (VSM) is designed to observe the Sun's vector magnetic field over the entire visible disk several times per day for at least two decades and will provide important new

information about the drivers of CMEs and other solar activity affecting the heliosphere. The VSM is being prepared for temporary installation at the agricultural site of the University of Arizona. We report on the status of the instrument, emphasizing early data and their comparison with observations from the NASA/NSO Spectromagnetograph at the Kitt Peak Vacuum Telescope and the HAO/NSO Advanced Stokes Polarimeter at the Sacramento Peak Dunn Vacuum Tower Telescope.

Author

Calibrating; Operator Performance; Solar Magnetic Field; Installing; Telescopes; Spectrometers; Magnetic Signatures

20030054377 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Inertial Stellar Compass (ISC): A Multifunction, Low Power, Attitude Determination Technology Breakthrough

Bauer, Frank H., Technical Monitor; Dennehy, Neil; Gambino, Joel; Maynard, Andrew; Brady, T.; Buckley, S.; Zinchuk, J.; January 14, 2003; 19 pp.; In English; 26th Annual AAS Guidance and Control Conference, 2-5 Feb. 2003, Breckenridge, CO, USA; Original contains black and white illustrations

Report No.(s): AAS-03-003; Copyright; Avail: CASI; [A03](#), Hardcopy

The Inertial Stellar Compass (ISC) is a miniature, low power, stellar inertial attitude determination system with an accuracy of better than 0.1 degree (1 sigma) in three axes. The ISC consumes only 3.5 Watts of power and is contained in a 2.5 kg package. With its embedded on-board processor, the ISC provides attitude quaternion information and has Lost-in-Space (LIS) initialization capability. The attitude accuracy and LIS capability are provided by combining a wide field of view Active Pixel Sensor (APS) star camera and Micro- ElectroMechanical System (MEMS) inertial sensor information in an integrated sensor system. The performance and small form factor make the ISC a useful sensor for a wide range of missions. In particular, the ISC represents an enabling, fully integrated, micro-satellite attitude determination system. Other applications include using the ISC as a single sensor solution for attitude determination on medium performance spacecraft and as a bolt on independent safe-hold sensor or coarse acquisition sensor for many other spacecraft. NASA's New Millennium Program (NMP) has selected the ISC technology for a Space Technology 6 (ST6) flight validation experiment scheduled for 2004. NMP missions, such as ST6, are intended to validate advanced technologies that have not flown in space in order to reduce the risk associated with their infusion into future NASA missions. This paper describes the design, operation, and performance of the ISC and outlines the technology validation plan. A number of mission applications for the ISC technology are highlighted, both for the baseline ST6 ISC configuration and more ambitious applications where ISC hardware and software modifications would be required. These applications demonstrate the wide range of Space and Earth Science missions that would benefit from infusion of the ISC technology.

Author

Systems Engineering; Compasses; Attitude Control; Microsatellites; Sensors; Technology Utilization; Stellar Systems

20030054393 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Simple Fabry-Perot based Instrument for Surface Pressure Sensing from Space

Heaps, William S.; March 11, 2002; 1 pp.; In English; 9th International Symposium on Remote Sensing, 22-27 Sep. 2002, Crete, Greece; No Copyright; Avail: Other Sources; Abstract Only

Mitchel and O'Brien observed in 1989 that a passive satellite measurement using the oxygen A band could exhibit a precision of better than 1% when used to make a surface pressure measurement. I will present a design and performance simulation for a Fabry-Perot interferometer based instrument which should exceed this level of performance. The design is small, inexpensive, and rugged. Preliminary results from a laboratory prototype of the instrument will be presented.

Author

Pressure Measurement; Fabry-Perot Interferometers; Design Analysis; Performance Prediction; Pressure

20030054562 Washington Univ., Seattle, WA, USA

Broadband IR Measurements for Modis Validation

Jessup, Andrew T.; [2003]; 8 pp.; In English

Contract(s)/Grant(s): NAG5-6463; No Copyright; Avail: CASI; [A02](#), Hardcopy

The primary objective of this research was the development and deployment of autonomous shipboard systems for infrared measurement of ocean surface skin temperature (SST). The focus was on demonstrating long-term, all-weather capability and supplying calibrated skin SST to the MODIS Ocean Science Team (MOCEAN). A secondary objective was to investigate and account for environmental factors that affect in situ measurements of SST for validation of satellite products. We developed and extensively deployed the Calibrated, InfraRed, In situ Measurement System, or CIRIMS, for at-sea validation of satellite-derived SST. The design goals included autonomous operation at sea for up to 6 months and an accuracy

of +/- 0.1 C. We used commercially available infrared pyrometers and a precision blackbody housed in a temperature-controlled enclosure. The sensors are calibrated at regular interval using a cylindro-cone target immersed in a temperature-controlled water bath, which allows the calibration points to follow the ocean surface temperature. An upward-looking pyrometer measures sky radiance in order to correct for the non-unity emissivity of water, which can introduce an error of up to 0.5 C. One of the most challenging aspects of the design was protection against the marine environment. A wide range of design strategies to provide accurate, all-weather measurements were investigated. The CIRIMS uses an infrared transparent window to completely protect the sensor and calibration blackbody from the marine environment. In order to evaluate the performance of this approach, the design incorporates the ability to make measurements with and without the window in the optical path.

Author

Ocean Data Acquisitions Systems; Ships; Sea Surface Temperature; Temperature Measurement; Design Analysis; Evaluation

37

MECHANICAL ENGINEERING

Includes mechanical devices and equipment; machine elements and processes. For cases where the application of a device or the host vehicle is emphasized see also the specific category where the application or vehicle is treated. For robotics see *63 Cybernetics, Artificial Intelligence, and Robotics*; and *54 Man/System Technology and Life Support*.

20030053329 Clarkson Univ., Potsdam, NY, USA

Inexpensive Method for Coating the Interior of Silica Growth Ampoules with Pyrolytic Boron Nitride

Wang, Jianbin; Regel, Liya L.; Wilcox, William R.; [2003]; 7 pp.; In English

Contract(s)/Grant(s): NAG8-1482; No Copyright; Avail: CASI; [A02](#), Hardcopy

An inexpensive method was developed for coating the interior of silica ampoules with hexagonal boron nitride. An aqueous solution of boric acid was used to coat the ampoule prior to drying in a vacuum at 200 C. This coating was converted to transparent boron nitride by heating in ammonia at 1000 C. Coated ampoules were used to achieve detached solidification of indium antimonide on earth.

Author

Coating; Ampoules; Silicon Dioxide; Boron Nitrides; Pyrolytic Materials

20030053349 NASA Marshall Space Flight Center, Huntsville, AL, USA

System for Controlling the Stirring Pin of a Friction Stir Welding Apparatus

Ding, R. Jeffrey, Inventor; Romine, Peter L., Inventor; Oelgoetz, Peter A., Inventor; December 24, 2002; 9 pp.; In English
Patent Info.: Filed 13 Oct. 2000; No Copyright; Avail: CASI; [A02](#), Hardcopy

A control is provided for a friction stir welding apparatus comprising a pin tool which includes a shoulder and a rotating pin extending outwardly from the shoulder of the pin tool and which, in use, is plunged into a workpiece formed contacting workpiece members to stir weld the members together. The control system controls the penetration of the pin tool into the workpiece members which are mounted on a support anvil. The control system includes a pin length controller for controlling pin length relative to the shoulder and for producing a corresponding pin length signal. A pin force sensor senses the force being exerted on the pin during welding and produces a corresponding actual pin force signal. A probe controller controls a probe extending outwardly from the pin, senses a parameter related to the distance between the probe and the supporting anvil and produces a corresponding probe signal. A workpiece standoff sensor senses the standoff distance between the workpiece and the standoff sensor and produces a corresponding standoff signal. A control unit receives the various signals, together with a weld schedule, and, based on these signals and the weld schedule, controls the pin length controller so as to control pin penetration into the workpiece.

Author

Controllars; Friction Stir Welding; Pins; Rotation

20030053382 Virginia Univ., Charlottesville, VA, USA

Load Diffusion in Composite and Smart Structures

Horgan, Cornelius O.; Ambur, D., Technical Monitor; Nemeth, M. P., Technical Monitor; [2003]; 9 pp.; In English

Contract(s)/Grant(s): NCC1-02019; No Copyright; Avail: CASI; [A02](#), Hardcopy

The research carried out here builds on our previous NASA supported research on the general topic of edge effects and load diffusion in composite structures. Further fundamental solid mechanics studies were carried out to provide a basis for

assessing the complicated modeling necessary for the multi-functional large scale structures used by NASA. An understanding of the fundamental mechanisms of load diffusion in composite subcomponents is essential in developing primary composite structures. Some specific problems recently considered were those of end effects in smart materials and structures, study of the stress response of pressurized linear piezoelectric cylinders for both static and steady rotating configurations, an analysis of the effect of pre-stressing and pre-polarization on the decay of end effects in piezoelectric solids and investigation of constitutive models for hardening rubber-like materials. Our goal in the study of load diffusion is the development of readily applicable results for the decay lengths in terms of non-dimensional material and geometric parameters. Analytical models of load diffusion behavior are extremely valuable in building an intuitive base for developing refined modeling strategies and assessing results from finite element analyses.

Derived from text

Composite Structures; Loads (Forces); Mathematical Models; Piezoelectricity; Hardening (Materials)

20030054532 ASRC Aerospace Corp., USA

Mechanical Engineering at KSC: 'How I spend My Hours from 9 to 5 and Draw a Paycheck'

Randazzo, John; Steinrock, Todd, Technical Monitor; January 2003; 4 pp.; In English; ASME UCF Student Section Meeting, Apr. 2003

Contract(s)/Grant(s): NAS10-03006

Report No.(s): KSC-2003-066; No Copyright; Avail: CASI; [A01](#), Hardcopy

This viewgraph presentation provides an overview of a senior mechanical engineer's role in designing and testing sensors to fly aboard the shuttle Discovery during STS-95 and STS-98. Topics covered include: software development tools, computation fluid dynamics, structural analysis, housing design, and systems integration.

Author

Mechanical Engineering; Spacecraft Design; Structural Analysis; Space Transportation System

38

QUALITY ASSURANCE AND RELIABILITY

Includes approaches to, and methods for reliability analysis and control, quality control, inspection, maintainability, and standardization.

20030053443 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Thermal Vacuum Test Performance of the Hubble Space Telescope (HST) Wide Field Camera 3 (WFC3) Variable Conductance Heat Pipe Assembly

Cleveland, Paul E.; Buchko, Matthew T.; Stavely, Richard A.; [2003]; 9 pp.; In English; International Conference on Environmental Systems, 7-10 Jul. 2003, Vancouver, British Columbia, Canada; Original contains color illustrations

Report No.(s): SAE-2003-01-2459; Copyright; Avail: CASI; [A02](#), Hardcopy

The Variable Conductance Heat Pipe (VCHP) Assembly of the HST Wide Field Camera 3 was subjected to thermal vacuum (TN) environmental testing. The test program included both maximum and minimum environments as well as simulated on-orbit cycling. Elements of the VCHP assembly included a VCHP, an optical bench cold plate with an imbedded constant conductance heat pipe, and a VCHP reservoir radiator with a proportionally controlled heater. The purpose of the test was to characterize and demonstrate the assembly's ability to control the temperature of the cold plate, which provides a stable thermal environment for the instrument's optical bench. This paper discusses the VCHP Assembly control performance and control authority during the dynamic hot and cold 90-minute orbit cycling test phases.

Author

Thermal Vacuum Tests; Cameras; Heat Pipes

39

STRUCTURAL MECHANICS

Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structures. For applications see *05 Aircraft Design, Testing and Performance*; and *18 Spacecraft Design, Testing and Performance*.

20030053338 NASA Marshall Space Flight Center, Huntsville, AL, USA

Passive Ball Capture Joint

Cloyd, Richard A., Inventor; Bryan, Thomas C., Inventor; April 1, 2003; 8 pp.; In English; Original contains black and white illustrations

Patent Info.: Filed 4 Sep. 2001; US-Patent-6,540,426; US-Patent-Appl-SN-949408; NASA-Case-MFS-31616-1; No Copyright; Avail: CASI; [A02](#), Hardcopy

A passive ball capture joint has a sleeve with a plurality of bores distributed about a circumference thereof and formed therethrough at an acute angle relative to the sleeve's longitudinal axis. A spring-loaded retainer is slidably fitted in each bore and is biased such that, if allowed, will extend at least partially into the sleeve to retain a ball therein. A ring, rotatably mounted about the bores, has an interior wall defining a plurality of shaped races that bear against the spring-loaded retainers. A mechanized rotational force producer is coupled to the ring. The ring can be rotated from a first position (that presses the retainers into the sleeve to lock the ball in place) to a second position (that allows the retainers to springback out of the sleeve to release the ball).

Official Gazette of the U.S. Patent and Trademark Office

Balls; Joints (Junctions); Mechanical Engineering; Couplings

20030053394 Army Research Lab., Hampton, VA, USA, NASA Langley Research Center, Hampton, VA, USA

Analytical and Experimental Study of Near-Threshold Interactions Between Crack Closure Mechanisms

Newman, John A.; Riddell, William T.; Piascik, Robert S.; May 2003; 18 pp.; In English

Contract(s)/Grant(s): RTOP 706-61-11-03

Report No.(s): NASA/TM-2003-211755; NAS 1.15:211755; L-18207; ARL-TR-2774; No Copyright; Avail: CASI; [A03](#), Hardcopy

The results of an analytical closure model that considers contributions and interactions between plasticity-, roughness-, and oxide-induced crack closure mechanisms are presented and compared with experimental data. The analytical model is shown to provide a good description of the combined influences of crack roughness, oxide debris, and plasticity in the near-threshold regime. Furthermore, analytical results indicate that closure mechanisms interact in a non-linear manner such that the total amount of closure is not the sum of closure contributions for each mechanism.

Author

Crack Closure; Mathematical Models; Plastic Properties; Surface Roughness; Oxides; Debris

20030054510 NASA Ames Research Center, Moffett Field, CA, USA

Understanding Vibration Spectra of Planetary Gear Systems for Fault Detection

Mosher, Marianne; [2003]; 1 pp.; In English; ASME/AGMA 2003 International Power Transmission and Gearing, 2-6 Sep. 2003, Chicago, IL, USA

Contract(s)/Grant(s): RTOP 704-01-30; No Copyright; Avail: Other Sources; Abstract Only

An understanding of the vibration spectra is very useful for any gear fault detection scheme based upon vibration measurements. The vibration measured from planetary gears is complicated. Sternfeld noted the presence of sidebands about the gear mesh harmonics spaced at the planet passage frequency in spectra measured near the ring gear of a CH-47 helicopter. McFadden proposes a simple model of the vibration transmission that predicts high spectral amplitudes at multiples of the planet passage frequency, for planetary gears with evenly spaced planets. This model correctly predicts no strong signal at the meshing frequency when the number of teeth on the ring gear is not an integer multiple of the number of planets. This paper will describe a model for planetary gear vibration spectra developed from the ideas started in reference. This model predicts vibration to occur only at frequencies that are multiples of the planet repetition passage frequency and clustered around gear mesh harmonics. Vibration measurements will be shown from tri-axial accelerometers mounted on three different planetary gear systems and compared with the model. The model correctly predicts the frequencies with large components around the first several gear mesh harmonics in measurements for systems with uniformly and nonuniformly spaced planet gears. Measurements do not confirm some of the more detailed features predicted by the model. Discrepancies of the ideal model to the measurements are believed due to simplifications in the model and will be discussed. Fault detection will be discussed applying the understanding will be discussed.

Author

Harmonics; Gear Teeth; Mechanical Drives; Fault Detection; Vibration Measurement; Mathematical Models; Frequencies; Vibrational Spectra

GEOSCIENCES (GENERAL)

Includes general research topics related to the Earth sciences, and the specific areas of petrology, mineralogy, and general geology. For other specific topics in geosciences see *categories 42 through 48*.

20030053139 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Orbital Noise of the Earth Causes Intensity Fluctuation in the Geomagnetic Field

Liu, Han-Shou; Kolenkiewicz, R.; Wade, C., Jr.; [2003]; 11 pp.; In English; Original contains color illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

Orbital noise of Earth's obliquity can provide an insight into the core of the Earth that causes intensity fluctuations in the geomagnetic field. Here we show that noise spectrum of the obliquity frequency have revealed a series of frequency periods centered at 250-, 100-, 50-, 41-, 30-, and 26-kyr which are almost identical with the observed spectral peaks from the composite curve of 33 records of relative paleointensity spanning the past 800 kyr (Sint-800 data). A continuous record for the past two million years also reveals the presence of the major 100 kyr periodicity in obliquity noise and geomagnetic intensity fluctuations. These results of correlation suggest that obliquity noise may power the dynamo, located in the liquid outer core of the Earth, which generates the geomagnetic field.

Author

Magnetic Anomalies; Geomagnetism; Magnetic Flux; Celestial Mechanics; Earth Core; Core-Mantle Boundary; Orbital Resonances (Celestial Mechanics); Noise Spectra

20030054391 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Causes of Long-Term Drought in the USA Great Plains

Schubert, Siegfried D.; Suarez, Max J.; Pegion, Philip J.; Koster, Randal D.; Bacmeister, Julio T.; [2003]; 1 pp.; In English; 27th Climate Diagnostics and Prediction Workshop, 21-25 Oct. 2002, Fairfax, VA, USA; No Copyright; Avail: Other Sources; Abstract Only

This study examines the causes of long term droughts in the USA Great Plains (USGP). The focus is on the relative roles of slowly varying SSTs and interactions with soil moisture. The results from ensembles of long term (1930-1999) simulations carried out with the NASA Seasonal-to- Interannual Prediction Project (NSIPP-1) atmospheric general circulation model (AGCM) show that the SSTs account for about 1/3 of the total low frequency rainfall variance in the USGP. Results from idealized experiments with climatological SST suggest that the remaining low frequency variance in the USGP precipitation is the result of interactions with soil moisture. In particular, simulations with soil moisture feedback show a five-fold increase in the variance in annual USGP precipitation compared with simulations in which the soil feedback is excluded. In addition to increasing variance, the interactions with the soil introduce year-to-year memory in the hydrological cycle that is consistent with a red noise process, in which the deep soil is forced by white noise and damped with a time scale of about 2 years. As such, the role of low frequency SST variability is to introduce a bias to the net forcing on the soil moisture that drives the random process preferentially to either wet or dry conditions.

Author

Great Plains Corridor (North America); Surface Temperature; Soil Moisture; Drought; Seas

20030054489 NASA Ames Research Center, Moffett Field, CA, USA

Blowing in the Wind: II. Creation and Redistribution of Refractory Inclusions in a Turbulent Protoplanetary Nebula

Cuzzi, Jeffrey N.; Davis, Sanford S.; Dobrovolskis, Anthony R.; Fonda, Mark, Technical Monitor; April 14, 2003; 1 pp.; In English

Contract(s)/Grant(s): RTOP 344-37-22-03; No Copyright; Avail: Other Sources; Abstract Only

Ca-Al rich refractory mineral inclusions (CAIs) found at 1-6% mass fraction in primitive chondrites appear to be 1-3 million years older than the dominant (chondrule) components which were accreted into the same parent bodies. A prevalent concern is that it is difficult to retain CAIs for this long against gas-drag-induced radial drift into the sun. We reassess the situation in terms of a hot inner (turbulent) nebula context for CAI formation, using analytical models of nebula evolution and particle diffusion. We show that outward radial diffusion in a weakly turbulent nebula can overwhelm inward drift, and prevent significant numbers of CAI-size particles from being lost into the sun for times on the order of $10(\exp 6)$ years. CAIs can form early, when the inner nebula was hot, and persist in sufficient abundance to be incorporated into primitive planetesimals at a much later time. Small (less than or approx. equal to 0.1 mm diameter) CAIs persist for longer times than large (greater than or approx. equal to 5mm diameter ones). To obtain a quantitative match to the observed volume fractions of CAIs in chondrites, another process must be allowed for: a substantial enhancement of the inner hot nebula in silicate-forming material,

which we suggest was caused by rapid inward drift of meter-sized objects. This early in nebula history, the drifting rubble would have a carbon content probably an order of magnitude larger than even the most primitive (CI) carbonaceous chondrites. Abundant carbon in the evaporating material would help keep the nebula oxygen fugacity low, plausibly solar, as inferred for the formation environment of CAIs. The associated production of a larger than canonical amount of CO₂ might also play a role in mass-independent fractionation of oxygen isotopes, leaving the gas rich in ¹⁶O as inferred from CAIs and other high temperature condensates.

Author

Inclusions; Planetary Nebulae; Minerals; Carbon; Carbonaceous Chondrites

20030054535 Colorado Univ., Boulder, CO, USA

Exploring New Methods of Displaying Bit-Level Quality and Other Flags for MODIS Data

Khalsa, Siri Jodha Singh; Weaver, Ron; [2003]; 9 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NAG5-11292

Report No.(s): QRS-01-0015; No Copyright; Avail: CASI; [A02](#), Hardcopy

The NASA Distributed Active Archive Center (DAAC) at the National Snow and Ice Data Center (NSIDC) archives and distributes snow and sea ice products derived from the MODerate resolution Imaging Spectroradiometer (MODIS) on board NASA's Terra and Aqua satellites. All MODIS standard products are in the Earth Observing System version of the Hierarchical Data Format (HDF-EOS). The MODIS science team has packed a wealth of information into each HDF-EOS file. In addition to the science data arrays containing the geophysical product, there are often pixel-level Quality Assurance arrays which are important for understanding and interpreting the science data. Currently, researchers are limited in their ability to access and decode information stored as individual bits in many of the MODIS science products. Commercial and public domain utilities give users access, in varying degrees, to the elements inside MODIS HDF-EOS files. However, when attempting to visualize the data, users are confronted with the fact that many of the elements actually represent eight different 1-bit arrays packed into a single byte array. This project addressed the need for researchers to access bit-level information inside MODIS data files. In an previous NASA-funded project (ESDIS Prototype ID 50.0) we developed a visualization tool tailored to polar gridded HDF-EOS data set. This tool, called the Polar researchers to access, geolocate, visualize, and subset data that originate from different sources and have different spatial resolutions but which are placed on a common polar grid. The bit-level visualization function developed under this project was added to PHDIS, resulting in a versatile tool that serves a variety of needs. We call this the EOS Imaging Tool.

Author

Earth Observing System (Eos); Geophysics; Sea Ice; Snow; Geophysical Observatories

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EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth features, phenomena and resources by aircraft, balloon, rocket, and spacecraft; analysis of remote sensing data and imagery; development of remote sensing products; photogrammetry; and aerial photography. For related instrumentation see *35 Instrumentation and Photography*.

20030053133 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Discoveries about Tropical Tropospheric Ozone from Satellite and SHADOZ (Southern Hemisphere Additional Ozonesondes) and a Future Perspective on NASA's Ozone Sensors

Thompson, Anne; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

We have been producing near-real tropical tropospheric ozone ('TTO') data from TOMS since 1997 with Prof. Hudson and students at the University of Maryland. Maps for 1996-2000 for the operational Earth-Probe instrument reside at: <http://www.atmos.umd.edu/~trope>. We also have archived 'TTO' data from the Nimbus 7/TOMS satellite (1979-1992). The tropics is a region strongly influenced by natural variability and anthropogenic activity and the satellite data have been used to track biomass burning pollution and to detect interannual variability and climate signals in ozone. We look forward to future ozone sensors from NASA; four will be launched in 2004 as part of the EOS AURA Mission. The satellite view of chemical-dynamical interactions in tropospheric ozone is not adequate to capture vertical variability. Thus, in 1998, NASA's Goddard Space Flight Center, NOAA's Climate Monitoring and Diagnostics Laboratory (CMDL) and a team of international sponsors established the SHADOZ (Southern Hemisphere ADditional OZonesondes) project to address the gap in tropical ozone soundings. SHADOZ augments launches at selected sites and provides a public archive of ozonesonde data from twelve tropical and subtropical stations at <http://croc.nsf.nasa.gov/shadoz>. The stations are: Ascension Island; Nairobi, Kenya; Irene,

South Africa; Reunion Island; Watukosek, Java; Fiji; Tahiti; American Samoa; San Cristobal, Galapagos; Natal, Brazil, Malindi, Kenya; Paramaribo, Surinam. From the first 3-4 years of data (presently greater than 1700 sondes), the following features emerge: (a) highly variable tropospheric ozone; (b) a zonal wave-one pattern in tropospheric column ozone; (c) tropospheric ozone variability over the Indian and Pacific Ocean displays strong convective signatures.

Author

Satellite Observation; Ozone; Tropical Regions; Troposphere; Annual Variations; Atmospheric Chemistry; Gas-Liquid Interactions

20030053141 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Blowing Snow Over the Antarctic Plateau

Mahesh, Ashwin; Eager, Rebecca; Campbell, James R.; Spinhirne, James D.; [2002]; 32 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; [A03](#), Hardcopy

Studies of blowing snow over Antarctica have been limited greatly by the remoteness and harsh conditions of the region. Space-based observations are also of lesser value than elsewhere, given the similarities between ice clouds and snow-covered surfaces, both at infrared and visible wavelengths. It is only in recent years that routine ground-based observation programs have acquired sufficient data to overcome the gap in our understanding of surface blowing snow. In this paper, observations of blowing snow from visual observers' records as well as ground-based spectral and lidar programs at South Pole station are analyzed to obtain the first climatology of blowing snow over the Antarctic plateau. Occurrence frequencies, correlation with wind direction and speed, typical layer heights, as well as optical depths are determined. Blowing snow is seen in roughly one third of the visual observations and occurs under a narrow range of wind directions. The near-surface layers typically a few hundred meters thick emit radiances similar to those from thin clouds. Because blowing snow remains close to the surface and is frequently present, it will produce small biases in space-borne altimetry; these must be properly estimated and corrected.

Author

Antarctic Regions; Snow; Climatology; Optical Properties; Visual Observation; Optical Radar

20030053414 National Academy of Sciences - National Research Council, Greenbelt, MD, USA

Two Surface Temperature Retrieval Methods Compared Over Agricultural Lands

French, Andrew N.; Schmugge, Thomas J.; Jacob, Frederic; Ogawa, Kenta; Houser, Paul R., Technical Monitor; [2002]; 1 pp.; In English; SPIE Symposium: Remote Sensing for Agriculture Ecosystems and Hydrology IV, 22-27 Sep. 2002, Agia Pelagia, Crete, Greece; No Copyright; Avail: Other Sources; Abstract Only

Accurate, spatially distributed surface temperatures are required for modeling evapotranspiration (ET) over agricultural fields under wide ranging conditions, including stressed and unstressed vegetation. Modeling approaches that use surface temperature observations, however, have the burden of estimating surface emissivities. Emissivity estimation, the subject of much recent research, is facilitated by observations in multiple thermal infrared bands. But it is nevertheless a difficult task. Using observations from a multiband thermal sensor, the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), estimated surface emissivities and temperatures are retrieved in two different ways: the temperature emissivity separation approach (TES) and the normalized emissivity approach (NEM). Both rely upon empirical relationships, but the assumed relationships are different. TES relies upon a relationship between the minimum spectral emissivity and the range of observed emissivities. NEM relies upon an assumption that at least one thermal band has a pre-determined emissivity (close to 1.0). The benefits and consequences of each approach will be demonstrated for two different landscapes: one in central Oklahoma, USA and another in southern New Mexico.

Author

Land Surface Temperature; Evapotranspiration; Agriculture; Vegetation

20030053417 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Use of TRMM Rainfall Information in Improving Long-Term, Satellite-Based Global Precipitation Analyses

Starr, David OC., Technical Monitor; Adler, Robert F.; Huffman, George; Curtis, Scott; Bolvin, David; Nelkin, Eric; [2002]; 1 pp.; In English; International TRMM Science Conference, 22-26 Jul. 2002, Honolulu, HI, USA; No Copyright; Avail: Other Sources; Abstract Only

The TRMM rainfall products are inter-compared among themselves and to the 23 year, monthly, globally complete precipitation analysis of the World Climate Research Program's (WCRP/ GEWEX) Global Precipitation Climatology Project (GPCP). Ways in which the TRMM-based estimates can be used to improve the long-term data set are described. These include improvement of the passive microwave algorithm that is applied to the 15 year SSM/I record and calibration or

adjustment of the current GPCP fields utilizing the 4-5 year overlap of TRMM and GPCP. A comparison of the GPCP monthly surface precipitation fields and the TRMM-based multi-satellite analyses indicates that the two are similar, but have significant differences that relate to the different input data sets. Although on a zonal average basis over the ocean the two analyses are similar in the deep Tropics, there are subtle differences between the eastern and western Pacific Ocean in the relative magnitudes. In mid-latitudes the GPCP has somewhat larger mean precipitation than TRMM. Statistical comparisons of TRMM and GPCP monthly fields are carried out in terms of histogram matching for both ocean and land regions and for small areas to diagnose differences. These comparisons form the basis for a TRMM calibration of the GPCP fields using matched histograms over regional areas as a function of season. Although final application of this procedure will likely await the Version 6 of the TRMM products, tests using Version 5 are shown that provide a TRMM-calibrated GPCP version that will produce an improved climatology and a more accurate month-to-month precipitation analysis for the last 20 years.

Author

Trmm Satellite; Rain; Data Management; Performance Prediction; Estimates; Algorithms

20030054359 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Dynamics and Properties of Global Aerosol using MODIS, AERONET and GOCART Model

Kaufman, Yoram; Chin, Mian; Reme, Lorraine; Tanre, Didier; Mattoo, Shana; [2002]; 1 pp.; In English; NCAR Conference, 9-17 Jul. 2002, Boulder, CO, USA; Copyright; Avail: Other Sources; Abstract Only

Recently produced daily Moderate Resolution Imaging Spectroradiometer (MODIS) aerosol data for the whole year of 2001 are used to show the concentration and dynamics of aerosol over ocean and large parts of the continents. The data were validated against the Aerosol Robotic Network (AERONET) measurements over land and ocean in a special issue in GRL now in press. Monthly averages and a movie based on the daily data are produced and used to demonstrate the spatial and temporal evolution of aerosol. The MODIS wide spectral range is used to distinguish fine smoke and pollution aerosol from coarse dust and salt. The aerosol is observed above ocean and land. The movie produced from the MODIS data provides a new dimension to aerosol observations by showing the dynamics of the system. For example in February smoke and dust emitted from the Sahel and West Africa is shown to travel to the North-East Atlantic. In April heavy dust and pollution from East Asia is shown to travel to North America. In May-June pollution and dust play a dynamical dance in the Arabian Sea and Bay of Bengal. In Aug-September smoke from South Africa and South America is shown to pulsate in tandem and to periodically to be transported to the otherwise pristine Southern part of the Southern Hemisphere. The MODIS data are compared with the Georgia Tech/Goddard Global Ozone Chemistry Aerosol Radiation Transport (GOCART) model to test and adjust source and sink strengths in the model and to study the effect of clouds on the representation of the satellite data.

Author

Aerosols; Atmospheric Models; Spatial Distribution; Temporal Distribution

20030054362 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Characterization of Dust Properties Near Source Region During ACE-Asia: A Column Satellite-Surface Perspective

Tsay, S. -C.; Ji, Q.; Chu, A.; Hsu, C.; Holben, B.; Campbell, J.; Welton, E. J.; Shu, P. K.; [2002]; 1 pp.; In English; 7th Scientific Conference of the International Global Atmospheric Chemistry Project, 18-25 Sep. 2002, Crete, Greece; No Copyright; Avail: Other Sources; Abstract Only

Many recent field experiments are designed to study the compelling variability in spatial and temporal scale of both pollution-derived and naturally occurring aerosols, which often exist in high concentrations over eastern/southeastern Asia and along the rim of the western Pacific. For example, the ACE-Asia was conducted from March-May 2001 in the vicinity of the Taklimakan and Gobi deserts, East Coast of China, Yellow Sea, Korea, and Japan, along the pathway of Kosa (severe events that blanket East Asia with yellow desert dust, peaked in the Spring season). Asian dust typically originates in desert areas far from polluted urban regions. During transport, dust layers can interact with anthropogenic sulfate and soot aerosols from heavily polluted urban areas. Added to the complex effects of clouds and natural marine aerosols, dust particles reaching the marine environment can have drastically different properties than those from the source. Thus, understanding the unique temporal and spatial variations of Asian aerosols is of special importance in regional-to-global climate issues such as radiative forcing, the hydrological cycle, and primary biological productivity in the mid-Pacific Ocean. During ACE-Asia we have measured continuously aerosol physical/optical/radiative properties, column precipitable water amount, and surface reflectivity over homogeneous areas from surface. The inclusion of flux measurements permits the determination of aerosol radiative flux in addition to measurements of loading and optical depth. At the time of the Terra/MODIS, SeaWiFS, TOMS and other satellite overpasses, these ground-based observations can provide valuable data to compare with satellite retrievals

over land. Preliminary results will be presented and discussed their implications in regional climatic effects.

Author

Dust; Asia; Pollution Transport; Spatial Distribution; Temporal Distribution; Aerosols

20030054366 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Effects of Amazon Deforestation on Rainfall

Starr, David OC., Technical Monitor; Negri, Andrew J.; Adler, Robert F.; Surratt, Jason; [2002]; 1 pp.; In English; International TRMM Science Conference, 22-26 Jul. 2002, Honolulu, HI, USA; Copyright; Avail: Other Sources; Abstract Only

This study begins with the hypothesis that heavily deforested regions will experience increased surface heating, leading to local circulations that will ultimately enhance the rainfall, or at least, change the pattern of diurnal evolution of rainfall. This would be an important finding because several modeling studies have concluded that widespread deforestation would lead to decreased rainfall. Towards that end rain estimates from a combined GOES infrared/TRMM microwave technique were analyzed with respect to percent forest cover from Landsat data (courtesy of TRFIC at Michigan State University) and GOES visible channel data over a deforested area in Rondonia (southwest Brazil). Five 1' x 1' areas of varying forest cover were examined during the onset of the wet season in Amazonia (Aug-Sept), when the effects of the surface would not be dominated by large-scale synoptic weather patterns. Preliminary results revealed that: maximum rainfall fell in most deforested area; heavily forested areas received the least rainfall; cumulus cloud development initiated at borders; the amplitude of the diurnal cycle of precipitation was a function of th surface cover. Further work will be presented detailing effects of land surface cover on the GOES infrared-measured surface heating, GOES visible observed cumulus development, thunderstorm initiation based on the location of temperature minima in the infrared data, and estimated rainfall and its diurnal cycle from a combined GOES/TRMM technique. Rainfall estimates derived from non-geosynchronous microwave observations (i.e. Goddard Profiling Algorithm, GPROF) will also be examined.

Author

Amazon Region (South America); Deforestation; Precipitation (Meteorology); Climate Models; Microwave Imagery; Heat Transfer

20030054380 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Impact of Urbanization on the Precipitation Component of the Water Cycle: A New Perspective

Shephard, J. Marshal; [2002]; 1 pp.; In English; Seminar on Urban Induced Rainfall, 24-25 Nov. 2002, Charlottesville, VA, USA; No Copyright; Avail: Other Sources; Abstract Only

It is estimated that by the year 2025, 60% of the world s population will live in cities (UNFP, 1999). As cities continue to grow, urban sprawl (e.g., the expansion of urban surfaces outward into rural surroundings) creates unique problems related to land use, transportation, agriculture, housing, pollution, and development. Urban expansion also has measurable impacts on environmental processes. Urban areas modify boundary layer processes through the creation of an urban heat island (UHI). The literature indicates that the signature of the urban heat island effect may be resolvable in rainfall patterns over and downwind of metropolitan areas. However, a recent U.S. Weather Research Program panel concluded that more observational and modeling research is needed in this area (Dabberdt et al. 2000). NASA and other agencies initiated programs such as the Atlanta Land-use Analysis: Temperature and Air Quality Project (ATLANTA) (Quattrochi et al. 1998) which aimed to identify and understand how urban heat islands impact the environment. However, a comprehensive assessment of the role of urban-induced rainfall in the global water and energy cycle (GWEC) and cycling of freshwater was not a primary focus of these efforts. NASA's Earth Science Enterprise (ESE) seeks to develop a scientific understanding of the Earth system and its response to natural or human-induced changes to enable improved prediction capability for climate, weather, and natural hazards (NASA, 2000). Within this mission, the ESE has three basic thrusts: science research to increase Earth system knowledge; an applications program to transfer science knowledge to practical use in society; and a technology program to enable new, better, and cheaper capabilities for observing the earth. Within this framework, a research program is underway to further address the co-relationship between land cover use and change (e.g. urban development) and its impact on key components of the GWEC (e.g., precipitation). This presentation discusses the feasibility of using the TRMM or GPM satellite to identify precipitation anomalies likely caused by urbanization (Shepherd et al. 2002). Recent results from analyses of TRMM data around several major U.S. cities (e.g. Dallas, Atlanta, Houston) will be discussed. The presentation also summarizes a NASA-funded research effort to investigate the phenomenon of urban-induced precipitation anomalies using TRMM (future GPM) satellite-based remote sensing, an intensive ground observation/validation effort near Atlanta, and coupled atmosphere-land numerical modeling techniques.

Derived from text

Remote Sensing; Urban Development; Precipitation (Meteorology); Earth Sciences; Hydrological Cycle

20030054505 NASA Ames Research Center, Moffett Field, CA, USA

Temporal Stability of the NDVI-LAI Relationship in a Napa Valley Vineyard

Johnson, L. F.; [2003]; 1 pp.; In English

Contract(s)/Grant(s): RTOP 613-16-00; No Copyright; Avail: Other Sources; Abstract Only

Remotely sensed normalized difference vegetation index (NDVI) values, derived from high-resolution satellite images, were compared with ground measurements of vineyard leaf area index (LAI) periodically during the 2001 growing season. The two variables were strongly related at six ground calibration sites on each of four occasions ($r^2 = 0.91$ to 0.98). Linear regression equations relating the two variables did not significantly differ by observation date, and a single equation accounted for 92 percent of the variance in the combined dataset. Temporal stability of the relationship opens the possibility of transforming NDVI maps to LAI in the absence of repeated ground calibration fieldwork. In order to take advantage of this circumstance, however, steps should be taken to assure temporal consistency in spectral data values comprising the NDVI.

Author

Leaf Area Index; Normalized Difference Vegetation Index; Remote Sensing; Temporal Resolution; Stability

20030054518 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Limitations on Space-based Air Fluorescence Detector Apertures obtained from IR Cloud Measurements

White, Nicholas E., Technical Monitor; Krizmanic, John; Sokolsky, Pierre; Streitmatter, Robert; [2003]; 4 pp.; In English; 28th International Cosmic Ray Conference, 31 Jul - 7 Aug. 2003, Tsukuba, Japan; Copyright; Avail: CASI; [A01](#), Hardcopy

The presence of clouds between an airshower and a space-based detector can dramatically alter the measured signal characteristics due to absorption and scattering of the photonic signals. Furthermore, knowledge of the cloud cover in the observed atmosphere is needed to determine the instantaneous aperture of such a detector. Before exploring the complex nature of cloud-airshower interactions, we examine a simpler issue. We investigate the fraction of ultra-high energy cosmic ray events that may be expected to occur in volumes of the viewed atmosphere non-obscured by clouds. To this end, we use space-based IR data in concert with Monte Carlo simulated $10(\exp 20)$ eV airshowers to determine the acceptable event fractions. Earth-observing instruments, such as MODIS, measure detailed cloud configurations via a CO₂-slicing technique that can be used to determine cloud-top altitudes over large areas. Thus, events can be accepted if their observed 3-dimensional endpoints occur above low clouds as well as from areas of cloud-free atmosphere. An initial analysis has determined that by accepting airshowers that occur above low clouds, the non-obscured acceptance can be increased by approximately a factor of 3 over that obtained using a cloud-free criterion.

Author

Cloud Cover; Remote Sensors; Signal Processing; Absorption Spectra; Scattering; Cloud Physics; Cosmic Ray Showers; Apertures

20030054533 Boston Univ., Boston, MA, USA

Multi-Decadal Pathfinder Data Sets of Global Land Biophysical Variables from AVHRR and MODIS and their Use in GCM Studies of Biogeophysics and Biogeochemistry

Myneni, Ranga; [2003]; 8 pp.; In English

Contract(s)/Grant(s): NAG5-9547; No Copyright; Avail: CASI; [A02](#), Hardcopy

The problem of how the scale, or spatial resolution, of reflectance data impacts retrievals of vegetation leaf area index (LAI) and fraction absorbed photosynthetically active radiation (PAR) has been investigated. We define the goal of scaling as the process by which it is established that LAI and FPAR values derived from coarse resolution sensor data equal the arithmetic average of values derived independently from fine resolution sensor data. The increasing probability of land cover mixtures with decreasing resolution is defined as heterogeneity, which is a key concept in scaling studies. The effect of pixel heterogeneity on spectral reflectances and LAI/FPAR retrievals is investigated with 1 km Advanced Very High Resolution Radiometer (AVHRR) data aggregated to different coarse spatial resolutions. It is shown that LAI retrieval errors at coarse resolution are inversely related to the proportion of the dominant land cover in such pixel. Further, large errors in LAI retrievals are incurred when forests are minority biomes in non-forest pixels compared to when forest biomes are mixed with one another, and vice-versa. A physically based technique for scaling with explicit spatial resolution dependent radiative transfer formulation is developed. The successful application of this theory to scaling LAI retrievals from AVHRR data of different resolutions is demonstrated.

Author

Vegetative Index; Photosynthetically Active Radiation; Leaf Area Index; Spatial Resolution; Image Processing; Data Management

20030054534 Colorado Univ., Boulder, CO, USA

Characterizing the Siple Coast Ice Stream System using Satellite Images, Improved Topography, and Integrated Aerogeophysical Measurements

Scambos, Ted; May 19, 2003; 3 pp.; In English

Contract(s)/Grant(s): NAG5-7760; UC-153-0613

Report No.(s): NASA-RA-98-OES-03; No Copyright; Avail: CASI; [A01](#), Hardcopy

A technique for improving elevation maps of the polar ice sheets has been developed using AVHRR images. The technique is based on 'photoclinometry' or 'shape from shading', a technique used in the past for mapping planetary surfaces where little elevation information was available. The fundamental idea behind photoclinometry is using the brightness of imaged areas to infer their surface slope in the sun-illuminated direction. Our version of the method relies on a calibration of the images based on an existing lower-resolution digital elevation model (DEM), and then using the images to improve the input DEM resolution to the scale of the image data. Most current DEMs covering the ice sheets are based on Radar altimetry data, and have an inherent resolution of 10 to 25 km at best - although the grid scale of the DEM is often finer. These DEMs are highly accurate (to less than 1 meter); but they report the mean elevation of a broad area, thus erasing smaller features of glaciological interest. AVHRR image data, when accurately geolocated and calibrated, provides surface slope measurements (based on the pixel brightness under known lighting conditions) every approximately 1.1 km. The limitations of the technique are noisiness in the image data, small variations in the albedo of the snow surface, and the integration technique used to create an elevation field from the image-derived slopes. Our study applied the technique to several ice sheet areas having some elevation data; Greenland, the Amery Ice Shelf, the Institute Ice Stream, and the Siple Coast. For the latter, the input data set was laser-altimetry data collected under NSF's SOAR Facility (Support Office for Aerogeophysical Research) over the onset area of the Siple Coast. Over the course of the grant, the technique was greatly improved and modified, significantly improving accuracy and reducing noise from the images. Several publications resulted from the work, and a follow-on proposal to NASA has been submitted to apply the same method to MODIS data using ICESat and other elevation input information. This follow-on grant will explore two applications that are facilitated by the improved surface morphology characterizations of the ice sheets: accumulation and temperature variations near small undulations in the ice.

Author

Photogrammetry; Elevation; Ice Mapping; Ice; Satellite Altimetry; Radar Measurement; Image Processing

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ENVIRONMENT POLLUTION

Includes atmospheric, water, soil, noise, and thermal pollution.

20030053433 Delaware Univ., Newark, DE, USA

Application of Satellite Altimeter Data to Studies of Ocean Surface Heat Flux and Upper Ocean Thermal Processes

Yan, Xiao-Hai; [2003]; 8 pp.; In English

Contract(s)/Grant(s): NAG5-11773; No Copyright; Avail: CASI; [A02](#), Hardcopy

This is a one-year cost extension of previous grant but carrying a new award number for the administrative purpose. Supported by this one-year extension, the following research has continued and obtained significant results. 20 papers have been published (9) or submitted (11) to scientific journals in this one-year period. A brief summary of scientific results on: 1. A new method for estimation of the sensible heat flux using satellite vector winds, 2. Pacific warm pool excitation, earth rotation and El Nino Southern Oscillations, 3. A new study of the Mediterranean outflow and Meddies at 400-meter isopycnal surface using multi-sensor data, 4. Response of the coastal ocean to extremely high wind, and 5. Role of wind on the estimation of heat flux using satellite data, are provided below as examples of our many research results conducted in the last year,

Author

Satellite Altimetry; Remote Sensing; Thermodynamics; Ocean Dynamics; Sea Surface Temperature; Air Water Interactions

20030054349 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Ozone Pollution, Transport and Variability: Examples from Satellite and In-Situ Observations

Thompson, Anne; [2003]; 1 pp.; In English; 8th International Conference on Atmospheric Sciences and Applications to Air Quality, 11-13 Mar. 2003; No Copyright; Avail: Other Sources; Abstract Only

Regional and intercontinental transport of ozone has been observed from satellite, aircraft and sounding data. Over the past several years, we have developed new tropospheric ozone retrieval techniques from the TOMS (Total Ozone Mapping

Spectrometer) satellite instrument that are of sufficient resolution to follow pollution episodes. The modified-residual technique uses Level 2 total ozone and was used to follow the 1997 fires in the wake of the El-Nino-related fires in southeast Asia and the Indonesian maritime continent. The TOMS-direct method ('TDOT' = TOMS Direct Ozone in the Troposphere) is a newer algorithm that uses TOMS radiances directly to extract tropospheric ozone. Ozonesonde data that have been taken in campaigns (e.g. TRACE-P) and more consistently in the SHADOZ (Southern Hemisphere Additional Ozonesondes) project, reveal layers of pollution traceable with trajectories. Examples will be shown of long-range transport and recirculation over Africa during SAFARI-2000.

Author

Total Ozone Mapping Spectrometer; Ozone; Air Pollution; Pollution Transport; Algorithms; Satellite Observation

46

GEOPHYSICS

Includes Earth structure and dynamics, aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For related information see *47 Meteorology and Climatology*; and *93 Space Radiation*.

20030053126 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Time-Variable Gravity Signal due to Extratropic Pacific Water Mass Redistribution

Chao, B. F.; Boy, J. -P.; Cox, C. M.; Au, A. Y.; [2003]; 1 pp.; In English; EGS-AGU Joint Assembly, 6-11 Apr. 2003, Nice, France; No Copyright; Avail: Other Sources; Abstract Only

Using the satellite-laser-ranging (SLR) data, Cox and Chao [2002] reported the detection of a large post-1998 anomaly (in the form of a positive jump) in the time series of Earth's lowest-degree gravity harmonic 52, or the dynamic oblateness. Among several groups now examining the mass redistribution in the global geophysical fluids in search of the cause(s), we report here a temporally coinciding anomalies found in the extratropic north + south Pacific basins. Clearly seen in the leading EOFPC mode for extratropic Pacific, these anomalies occurred in sea-surface height, sea-surface temperature, and temperature- and salinity-depth profiles. We based our analysis on two different data sources: TOPEX/Poseidon altimetry, and the ECCO ocean general circulation model output assimilating T/P data. The magnitude of these changes, when converted to equivalent J2 change, appears to be a few times too small to explain the observed J2 directly. These findings, and the fact that the anomalies occurred following the strong 1997-98 El Nino, suggest strong geophysical connection of the interannual-to-decadal variation of 52 with the Pacific Decadal Oscillation (PDO) and the ultimate global-change processes that cause PDO. More work is underway, and additional independent data sources are examined, paying close attention to the fact that the J2 anomaly has been reversing back to normal since 2001. These include: (1) cryospheric contributions (melting of glaciers and ice sheets); (2) land hydrological contributions; (3) polar sea influences (e.g., via deep flow); (4) fluid flow in Earth's core; (5) time-variable gravity signals from SLR in higher harmonic degree/order, including J3, J4, (2,1), and (2,2) coefficients, considering their lower signal-to-noise ratios; (6) Earth rotation data in terms of length-of-day and polar motion.

Author

Gravitation; Anomalies; Geodesy; Earth Rotation; Time Series Analysis; Pacific Ocean

20030053197 NASA Goddard Space Flight Center, Greenbelt, MD, USA

A Systematic Global Mapping of the Radiation Field at Aviation Altitudes

Stassinopoulos, E. G.; Stauffer, C. A.; Brucker, G. J.; [2003]; 8 pp.; In English; Original contains color illustrations; Copyright; Avail: CASI; A02, Hardcopy

This paper presents early results from aircraft measurements made by a Low-LET Radiation Spectrometer (LoLRS), as part of a long-range effort to study the complex dynamics of the atmospheric radiation field. For this purpose, a comprehensive data base is being generated to enable a multivariable global mapping (and eventually modeling) of doses and Linear-Energy-Transfer (LET) spectra at aviation altitudes. To accomplish this, a methodical collection of data from the LoLRS (and other instruments), is planned over extended periods of time, in a manner that complements some previous isolated and sporadic measurements by other workers, with the objective to generate a detailed long-range description of the cosmic-ray induced particle environment and to study its variability and dependence on atmospheric thickness, magnetic latitude, L-shell or rigidity, space weather, solar particle events, solar cycle effects, magnetic field variation, diurnal and seasonal effects, and atmospheric weather. Analysis of initial data indicates that the dose is rising with increasing altitude and increasing magnetic latitude. Comparison of total doses with predictions is in good agreement.

Author

Mapping; Radiation Distribution; Atmospheric Radiation; Linear Energy Transfer (Let)

20030053419 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Column Closure Studies of Lower Tropospheric Aerosol and Water Vapor During ACE-Asia Using Airborne Sunphotometer, Airborne In-Situ and Ship-Based Lidar Measurements

Schmid, B.; Hegg, A.; Wang, J.; Bates, D.; Redemann, J.; Russells, P. B.; Livingston, J. M.; Jonsson, H. H.; Welton, E. J.; Seinfeld, J. H.; [2003]; 39 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; [A03](#), Hardcopy

We assess the consistency (closure) between solar beam attenuation by aerosols and water vapor measured by airborne sunphotometry and derived from airborne in-situ, and ship-based lidar measurements during the April 2001 Asian Pacific Regional Aerosol Characterization Experiment (ACE-Asia). The airborne data presented here were obtained aboard the Twin Otter aircraft. Comparing aerosol extinction $\sigma(550\text{ nm})$ from four different techniques shows good agreement for the vertical distribution of aerosol layers. However, the level of agreement in absolute magnitude of the derived aerosol extinction varied among the aerosol layers sampled. The $\sigma(550\text{ nm})$ computed from airborne in-situ size distribution and composition measurements shows good agreement with airborne sunphotometry in the marine boundary layer but is considerably lower in layers dominated by dust if the particles are assumed to be spherical. The $\sigma(550\text{ nm})$ from airborne in-situ scattering and absorption measurements are about approx. 13% lower than those obtained from airborne sunphotometry during 14 vertical profiles. Combining lidar and the airborne sunphotometer measurements reveals the prevalence of dust layers at altitudes up to 10 km with layer aerosol optical depth (from 3.5 to 10 km altitude) of approx. 0.1 to 0.2 (500 nm) and extinction-to-backscatter ratios of 59-71 sr (523 nm). The airborne sunphotometer aboard the Twin Otter reveals a relatively dry atmosphere during ACE-Asia with all water vapor columns less than 1.5 cm and water vapor densities w less than 12 g/cu m. Comparing layer water vapor amounts and w from the airborne sunphotometer to the same quantities measured with aircraft in-situ sensors leads to a high correlation ($r(\text{sup } 3)=0.96$) but the sunphotometer tends to underestimate w by 7%.

Author

Aerosols; Troposphere; Water Vapor; Solar Flux; Air Water Interactions; Atmospheric Boundary Layer; In Situ Measurement; Vertical Distribution

20030053422 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Global Vertical Rates from VLBI

Ma, Chopo; MacMillan, D.; Petrov, L.; [2003]; 1 pp.; In English; EGS-AGU Joint Assembly, 6-11 Apr. 2003, Nice, France; No Copyright; Avail: Other Sources; Abstract Only

The analysis of global VLBI observations provides vertical rates for 50 sites with formal errors less than 2 mm/yr and median formal error of 0.4 mm/yr. These sites are largely in Europe and North America with a few others in east Asia, Australia, South America and South Africa. The time interval of observations is up to 20 years. The error of the velocity reference frame is less than 0.5 mm/yr, but results from several sites with observations from more than one antenna suggest that the estimated vertical rates may have temporal variations or non-geophysical components. Comparisons with GPS rates and corresponding site position time series will be discussed.

Author

Errors; Estimating; Global Positioning System; Temporal Distribution; Time Series Analysis

20030053432 Clemson Univ., SC, USA

A Sounding Rocket Investigation of the Fine Structure in the Mesopause Region in Conjunction with High Spatial Resolution Lidar Measurements

Larsen, M. F.; May 21, 2003; 4 pp.; In English

Contract(s)/Grant(s): NAG5-5242; No Copyright; Avail: CASI; [A01](#), Hardcopy

The grant funds were provided to carry out chemical tracer wind and turbulence measurements in the mesosphere and lower thermosphere as part of the Turbulent Oxygen Mixing Experiment (TOMEX) for which Dr. James Hecht of the Aerospace Corp. was the Principal Investigator. Clemson University designed, built, and tested two chemical tracer release payload sections for the 21.126 and 21.127 payloads which, in addition, had photometer and ionization gauge instrumentation. The tracer chemical was trimethyl aluminum (TMA). The experiment was carried out at White Sands Missile Range in New Mexico on October 26, 2000. The location was chosen because of the proximity to the Starfire Optical Range (SOR) which hosted the powerful University of Illinois sodium lidar for an extended period prior to and also during the launch window. Since the SOR telescope is fully steerable, lidar measurements in the same volume sampled by the rocket were possible. The primary objective of the experiment was to measure the turbulent diffusion and mixing in the mesosphere and lower thermosphere, especially in layers characterized by convective and/or dynamical instabilities. The lidar, which is capable of

measuring the sodium density, temperatures, and winds with good range and time resolution, provided the launch criteria, as well as context measurements for the in situ rocket observations.

Derived from text

Turbulent Diffusion; Atmospheric Turbulence; Turbulent Mixing; Mesosphere; Thermosphere; Sounding Rockets

20030053446 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Prospect of Using Numerical Dynamo Model for Prediction of Geomagnetic Secular Variation

Kuang, Weijia; Tangborn, Andrew; [2003]; 1 pp.; In English; EGS-AGU Joint Assembly, 6-11 Apr. 2003, Nice, France; Copyright; Avail: Other Sources; Abstract Only

Modeling of the Earth's core has reached a level of maturity to where the incorporation of observations into the simulations through data assimilation has become feasible. Data assimilation is a method by which observations of a system are combined with a model output (or forecast) to obtain a best guess of the state of the system, called the analysis. The analysis is then used as an initial condition for the next forecast. By doing assimilation, not only we shall be able to predict partially secular variation of the core field, we could also use observations to further our understanding of dynamical states in the Earth's core. One of the first steps in the development of an assimilation system is a comparison between the observations and the model solution. The highly turbulent nature of core dynamics, along with the absence of any regular external forcing and constraint (which occurs in atmospheric dynamics, for example) means that short time comparisons (approx. 1000 years) cannot be made between model and observations. In order to make sensible comparisons, a direct insertion assimilation method has been implemented. In this approach, magnetic field observations at the Earth's surface have been substituted into the numerical model, such that the ratio of the multiple components and the dipole component from observation is adjusted at the core-mantle boundary and extended to the interior of the core, while the total magnetic energy remains unchanged. This adjusted magnetic field is then used as the initial field for a new simulation. In this way, a time tugged simulation is created which can then be compared directly with observations. We present numerical solutions with and without data insertion and discuss their implications for the development of a more rigorous assimilation system.

Author

Numerical Analysis; Mathematical Models; Secular Variations; Geomagnetism; Dynamo Theory

20030054348 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Application of Core Dynamics Modeling to Core-Mantle Interactions

Kuang, Weijia; [2003]; 1 pp.; In English; EGS-AGU Joint Assembly, 6-11 Apr. 2003, Nice, France; No Copyright; Avail: Other Sources; Abstract Only

Observations have demonstrated that length of day (LOD) variation on decadal time scales results from exchange of axial angular momentum between the solid mantle and the core. There are in general four core-mantle interaction mechanisms that couple the core and the mantle. Of which, three have been suggested likely the dominant coupling mechanism for the decadal core-mantle angular momentum exchange, namely, gravitational core-mantle coupling arising from density anomalies in the mantle and in the core (including the inner core), the electromagnetic coupling arising from Lorentz force in the electrically conducting lower mantle (e.g. D-layer), and the topographic coupling arising from non-hydrostatic pressure acting on the core-mantle boundary (CMB) topography. In the past decades, most effort has been on estimating the coupling torques from surface geomagnetic observations (kinematic approach), which has provided insights on the core dynamical processes. In the meantime, it also creates questions and concerns on approximations in the studies that may invalidate the corresponding conclusions. The most serious problem is perhaps the approximations that are inconsistent with dynamical processes in the core, such as inconsistencies between the core surface flow beneath the CMB and the CMB topography, and that between the D-layer electric conductivity and the approximations on toroidal field at the CMB. These inconsistencies can only be addressed with numerical core dynamics modeling. In the past few years, we applied our MoSST (Modular, Scalable, Self-consistent and Three-dimensional) core dynamics model to study core-mantle interactions together with geodynamo simulation, aiming at assessing the effect of the dynamical inconsistencies in the kinematic studies on core-mantle coupling torques. We focus on topographic and electromagnetic core-mantle couplings and find that, for the topographic coupling, the consistency between the core flow and the CMB topography is critical for correct evaluation of the coupling torque.

Derived from text

Core-Mantle Boundary; Mathematical Models; Geomagnetism; Angular Momentum; Dynamic Models

20030054354 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Space, Atmospheric, and Terrestrial Radiation Environments

Barth, Janet L.; Dyer, C. S.; Stassinopoulos, E. G.; [2003]; 25 pp.; In English; 2003 IEEE Nuclear and Space Radiation Effects Conference, 21-25 Jul. 2003; Copyright; Avail: CASI; [A03](#), Hardcopy

The progress on developing models of the radiation environment since the 1960s is reviewed with emphasis on models that can be applied to predicting the performance of microelectronics used in spacecraft and instruments. Space, atmospheric, and ground environments are included. It is shown that models must be adapted continually to account for increased understanding of the dynamics of the radiation environment and the changes in microelectronics technology. The IEEE Nuclear and Space Radiation Effects Conference is a vital forum to report model progress to the radiation effects research community.

Author

Atmospheric Radiation; Environment Models; Nuclear Radiation; Radiation Effects; Radiation Hazards

20030054376 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Calculations of Aerosol Radiative Forcing in the SAFARI Region from MODIS Data

Remer, L. A.; Ichoku, C.; Kaufman, Y. J.; Chu, D. A.; [2003]; 1 pp.; In English; SAFARI Workshop, 7-11 Oct. 2002, Charlottesville, VA, USA; No Copyright; Avail: Other Sources; Abstract Only

SAFARI 2000 provided the opportunity to validate MODIS aerosol retrievals and to correct any assumptions in the retrieval process. By comparing MODIS retrievals with ground-based sunphotometer data, we quantified the degree to which the MODIS algorithm underestimated the aerosol optical thickness. This discrepancy was attributed to underestimating the degree of light absorption by the southern African smoke aerosol. Correcting for this underestimation of absorption, produces more realistic aerosol retrievals that allow various applications of the MODIS aerosol products. One such application is the calculation of the aerosol radiative forcing at the top and bottom of the atmosphere. The combination of MODIS accuracy, coverage, resolution and the ability to separate fine and coarse mode make this calculation substantially advanced over previous attempts with other satellites. We focus on the oceans adjacent to southern Africa and use a solar radiative transfer model to perform the flux calculations. The forcing at the top of atmosphere is calculated to be 10 W/sq m, while the forcing at the surface is -26 W/sq m. These results resemble those calculated from INDOEX data, and are most sensitive to assumptions of aerosol absorption, the same parameter that initially interfered with our retrievals.

Author

Computation; Aerosols; Radiative Transfer; Optical Thickness

47

METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification.

20030053142 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Detection of Urban-Induced Rainfall Anomalies in a Major Coastal City

Shepherd, J. Marshall; Burian, Steven J.; [2002]; 21 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; [A03](#), Hardcopy

Urban heat islands (UHIs) are caused by the heat-retaining properties of surfaces usually found in urban cities like asphalt and concrete. The UHI can typically be observed on the evening TV weather map as warmer temperatures over the downtown of major cities and cooler temperatures in the suburbs and surrounding rural areas. The UHI has now become a widely acknowledged, observed, and researched phenomenon because of its broad environmental and societal implications. Interest in the UHI will intensify in the future as existing urban areas expand and rural areas urbanize. By the year 2025, more than 60% of the world's population will live in cities, with higher percentages expected in developed nations. The urban growth rate in the USA, for example, is estimated to be 12.5%, and the recent 2000 Census found that more than 80% of the population currently lives in urban areas. Furthermore, the U.S. population is not only growing but is tending to concentrate more in urban areas within the environmentally sensitive coastal zones. Urban growth creates unique and often contentious issues for policymakers related to land use zoning, transportation planning, agricultural production, housing and development, pollution, and natural resources protection. Urban expansion and its associated TJHIs also have measurable impacts on weather and climate processes. The UHI has been documented to affect local and regional temperature, wind patterns, and air quality

Author

Rain; Anomalies; Coasts; Meteorological Charts; Cities

20030053158 NASA Goddard Space Flight Center, Greenbelt, MD, USA

A TRMM-Based System for Real-Time Quasi-Global Merged Precipitation Estimates

Starr, David OC., Technical Monitor; Huffman, G. J.; Adler, R. F.; Stocker, E. F.; Bolvin, D. T.; Nelkin, E. J.; [2002]; 1 pp.; In English; International TRMM Science Conference, 22-26 Jul. 2002, Honolulu, HI, USA; Copyright; Avail: Other Sources; Abstract Only

A new processing system has been developed to combine IR and microwave data into 0.25 degree x 0.25 degree gridded precipitation estimates in near-real time over the latitude band plus or minus 50 degrees. Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI) precipitation estimates are used to calibrate Special Sensor Microwave/Imager (SSM/I) estimates, and Advanced Microwave Sounding Unit (AMSU) and Advanced Microwave Scanning Radiometer (AMSR) estimates, when available. The merged microwave estimates are then used to create a calibrated IR estimate in a Probability-Matched-Threshold approach for each individual hour. The microwave and IR estimates are combined for each 3-hour interval. Early results will be shown, including typical tropical and extratropical storm evolution and examples of the diurnal cycle. Major issues will be discussed, including the choice of IR algorithm, the approach for merging the IR and microwave estimates, extension to higher latitudes, retrospective processing back to 1999, and extension to the GPCP One-Degree Daily product (for which the authors are responsible). The work described here provides one approach to using data from the future NASA Global Precipitation Measurement program, which is designed to provide global coverage by low-orbit passive microwave satellites every three hours beginning around 2008.

Author

Precipitation (Meteorology); Trmm Satellite; Microwave Imagery; Remote Sensing; Estimating; Systems Engineering; Real Time Operation

20030053178 NASA Goddard Space Flight Center, Greenbelt, MD, USA

On the Measurement Errors of the Joss-Waldvogel Disdrometer

Tokay, Ali; Wolff, K. R.; Bashor, Paul; Dursun, O. K.; [2003]; 1 pp.; In English; American Meteorology Society Radar Meteorology Conference; Copyright; Avail: Other Sources; Abstract Only

The Joss-Waldvogel (JW) disdrometer is considered to be a reference instrument for drop size distribution measurements. It has been widely used in many field campaigns as part of validation efforts of radar rainfall estimation. It has also been incorporated in radar rain gauge rainfall observation networks at several ground validation sites for NASA's Tropical Rainfall Measuring Mission (TRMM). It is anticipated that the Joss-Waldvogel disdrometer will be one of the key instruments for ground validation for the upcoming Global Precipitation Measurement (GPM) mission. The JW is an impact type disdrometer and has several shortcomings. One such shortcoming is that it underestimates the number of small drops in heavy rain due to the disdrometer dead time. The detection of smaller drops is also suppressed in the presence of background noise. Further, drops larger than 5.0 to 5.5 mm diameter cannot be distinguished by the disdrometer. The JW assumes that all raindrops fall at their terminal fall speed. Ignoring the influence of vertical air motion on raindrop fall speed results in errors in determining the raindrop size. Also, the bulk descriptors of rainfall that requires the fall speed of the drops will be overestimated or underestimated due to errors in measured size and assumed fall velocity. Long-term observations from a two-dimensional video disdrometer are employed to simulate the JW disdrometer and assess how its shortcomings affect radar rainfall estimation. Data collected from collocated JW disdrometers were also incorporated in this study.

Author

Drop Size; Meteorological Radar; Precipitation (Meteorology); Instrument Errors; Detection

20030053186 Science Applications International Corp., USA

Comparison of Flow-Dependent and Static Error Correlation Models in the DAO Ozone Data Assimilation System

Wargan, K.; Stajner, I.; Pawson, S.; [2003]; 1 pp.; In English; SPARC Data Assimilation Workshop, 4-6 Jun. 2003, Florence, Italy; No Copyright; Avail: Other Sources; Abstract Only

In a data assimilation system the forecast error covariance matrix governs the way in which the data information is spread throughout the model grid. Implementation of a correct method of assigning covariances is expected to have an impact on the analysis results. The simplest models assume that correlations are constant in time and isotropic or nearly isotropic. In such models the analysis depends on the dynamics only through assumed error standard deviations. In applications to atmospheric tracer data assimilation this may lead to inaccuracies, especially in regions with strong wind shears or high gradient of potential vorticity, as well as in areas where no data are available. In order to overcome this problem we have developed a flow-dependent covariance model that is based on short term evolution of error correlations. The presentation compares performance of a static and a flow-dependent model applied to a global three-dimensional ozone data assimilation system developed at NASA's Data Assimilation Office. We will present some results of validation against WMO balloon-borne sondes

and the Polar Ozone and Aerosol Measurement (POAM) III instrument. Experiments show that allowing forecast error correlations to evolve with the flow results in positive impact on assimilated ozone within the regions where data were not assimilated, particularly at high latitudes in both hemispheres and in the troposphere. We will also discuss statistical characteristics of both models; in particular we will argue that including evolution of error correlations leads to stronger internal consistency of a data assimilation ,

Author

Aerosols; Correlation; Data Systems; Error Analysis; Ozone; Standard Deviation; Static Models

20030053198 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Summer Synoptic-Scale Waves over Tropical West Africa Observed by TRMM

Starr, David O., Technical Monitor; Gu, Guojun; Adler, Robert F.; Huffman, George J.; Curtis, Scott; [2003]; 22 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; [A03](#), Hardcopy

A 5-year daily rainfall dataset (3B42) from TRMM (Tropical Rainfall Measuring Mission) is used to investigate the activity and properties of westward-propagating synoptic-scale waves over tropical West Africa. Evident wave signals appearing in wavenumber-frequency space show their modulations on the surface rainfall pattern during the boreal summer. Interannual variability exists in both their intensity and spectral properties, i. e., dominant frequency and wavenumber ranges. These variabilities can be partly ascribed to year-to-year variations of their embedded large-scale environment, especially the status of mid-tropospheric African easterly jet (AEJ). Generally, a stronger (weaker) AEJ indicates more (less) instability energy yielding a stronger (weaker) wave activity season. Seasonal mean rainfall has shown an impact on these waves in some years. However, the impact is not as clear and consistent as AEJ, implying the complexity of their relationship with large-scale environment. To fully understand interannual variability of synoptic-scale waves over tropical West Africa, including the variability in their preferred frequencies and wavenumbers, it is therefore necessary to examine possible intra-seasonal variations existing in both wave activity and large-scale fields, in addition to their structure, propagation, and associated convection.

Author

Summer; Rain; Tropical Regions; Africa; Trmm Satellite

20030053423 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Is There Really an Intermittent Biennial Oscillation in the Great Plains Low-Level Jet Over Texas?

Helfand, H. Mark; [2002]; 2 pp.; In English; 27th Climate Diagnostics and Prediction Workshop, 21-25 Oct. 2002, Fairfax, VA, USA; No Copyright; Avail: Other Sources; Abstract Only

In the 15-year GEOS-1 reanalysis data set, a maximum of interannual variance of low-level meridional flow for the warm season (May through August) occurs over southeast Texas. This variance maximum seems to be dominated by a marked biennial oscillation that occurs only during the first 6 (or possibly 8) years of the reanalysis period (1980-85 or possibly 1980-1987) and then completely disappears by the 9th year. This biennial oscillation seems to be associated with interannual fluctuations in ground wetness, surface temperature and surface pressure gradients over Texas. The periods of drier soil lead to warmer surface temperatures, lower surface pressures, stronger pressure gradients between Texas and the Gulf of Mexico and stronger southerly winds. This intermittent biennial oscillation is also evident in corresponding fields for the the NCEP/NCAR reanalysis data set for the years 1978-1985 (and possibly from 1978- 1987) and 1995-2000, but not during other periods. There are also obvious biennial oscillations evident during these periods in U.S. Climate Division records for the Palmer Drought Severity Index (PDSI) for Texas. Month-by-month correlations of this index with certain el Nino related indices are as high as .45 for the first period and as high as .55 or .6 for the second period for some regions in Texas. The seasonal cycle of the biennial signal in the PDSI and precipitation for the first period suggest that the drought in Texas and Mexico is ended (caused) by a reversal in the sign of anomalies in precipitation rate for the fall/winter season. Analysis of tropical Pacific SST patterns shows a .5 to .75 K biennial oscillation of SSTs along the precipitation-free track to the southwest of the Mexican coast during the fall and winter months of the 1978 to 1985 period that might explain the reversal in precipitation anomalies and hence the entire intermittent biennial oscillation in ground hydrology and low-level flow.

Author

Anomalies; Climate; El Nino; Great Plains Corridor (North America); Gulf Of Mexico; Jet Streams (Meteorology); Oscillations

20030053434 Science Applications International Corp., Beltsville, MD, USA, NASA Goddard Space Flight Center, Greenbelt, MD, USA

Unexplained Discontinuity in the US Radiosonde Temperature Data, Part 2, Stratosphere

Redder, Christopher R.; Luers, Jim K.; Eskridge, Robert E.; April 15, 2003; 55 pp.; In English; Original contains color illustrations; Copyright; Avail: CASI; [A04](#), Hardcopy

In part I of this paper, the USA (US) radiosonde temperature data are shown to have significant and unexplained inhomogeneities in the mid-troposphere. This part discusses the differences between observations taken at 0 and 12 UTC especially in the stratosphere by the Vaisala RS80 radiosondes that are integrated within the National Weather Service's (NWS) Micro-ART system. The results show that there is a large maxima in the horizontal distribution of the monthly means of the 0/12 UTC differences over the central US that is absent over Canada and this maxima is as large as 5 C at 10 hPa. The vertical profiles of the root-mean-square of the monthly means are much larger in the US than those elsewhere. The data clearly shows that the 0/12 UTC differences are largely artificial especially over the central US and originate in the post processing software at observing stations, thus confirming the findings in part I. Special flight data from the NWS's test facility at Sterling, Va. have been obtained. This data can be used to deduce the bias correction applied by Vaisala's post processing system. By analyzing the correction data, it can be shown that the inconsistencies with non-US Vaisala RS80 data as well as most of the large 0/12 UTC differences over the US can be accounted for by multiplying the reported elapsed time (i.e. time since launch) by the factor which is incorrectly applied by the post processing software. After being presented with the findings in this paper, Vaisala further isolated the source of the inconsistencies to a software coding error in the radiation bias correction scheme. The error effects only the software installed at US stations.

Author

Discontinuity; Radiosondes; Temperature Profiles; Stratosphere; Data Acquisition

20030053438 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Sensitivity Studies for Assimilated Ozone Profiles

Stajner, Ivanka; Winslow, Nathan; Wargan, Krzysztof; Rood, Richard; Pawson, Steven; [2002]; 1 pp.; In English; AMS 12th Conference on the Middle Atmosphere, 4-7 Nov. 2002, San Antonio, TX, USA; No Copyright; Avail: Other Sources; Abstract Only

An ozone data assimilation system at the NASA/Goddard Data Assimilation Office (DAO) produces three-dimensional global ozone fields. They are obtained by assimilating ozone retrieved from the Solar Backscatter UltraViolet/2 (SBUV/2) instrument and the Earth Probe Total Ozone Mapping Spectrometer (EP TOMS) measurements into an off-line parameterized chemistry and transport model. In this talk we focus on the quality of lower stratospheric assimilated ozone profiles. Ozone in the lower stratosphere plays a key role in the forcing of climate. A biased ozone field in this region will adversely impact calculations of the stratosphere-troposphere exchange and, when used as a first guess in retrievals, the values determined from satellite observations. The SBUV/2 ozone data have a coarse vertical resolution with increased uncertainty below the ozone maximum, and TOMS provides only total ozone columns. Thus, the assimilated ozone profiles in the lower stratosphere are only weakly constrained by the incoming SBUV and TOMS data. Consequently, the assimilated ozone distribution should be sensitive to changes in inputs to the statistical analysis scheme. We investigate the sensitivity of assimilated ozone profiles to changes in a variety of system inputs: TOMS and SBUV/2 data selection, forecast and observations error covariance models, inclusion or omission of a parameterized chemistry model, and different versions of DAO assimilated wind fields used to drive the transport model. Comparisons of assimilated ozone fields with independent observations, primarily ozone sondes, are used to determine the impact of each of these changes.

Author

Data Systems; Information Systems; Data Integration; Ozone; Statistical Analysis; Atmospheric Models; Sensitivity

20030053439 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Impact of TRMM Data on Numerical Forecast of Mesoscale Systems

Pu, Zhao-Xia; Tao, Wei-Kuo; [2002]; 1 pp.; In English; International TRMM Science Conference, 22-26 Jul. 2002, Honolulu, HI, USA; No Copyright; Avail: Other Sources; Abstract Only

The impact of surface rainfall data derived from the TRMM Microwave Image (TMI) on the numerical forecast of mesoscale systems is evaluated. A series of numerical experiments are performed that assimilate TMI rainfall data into the Penn State University/National Centers for Atmospheric Research (PSU/NCAR) Mesoscale Model version 5 (MM5) using a four-dimensional variational data assimilation (4DVAR) technique. Experiments are conducted incorporating TMI rainfall data into the mesoscale model to improve hurricane initialization. It is found that assimilation of rainfall data into the model is beneficial in producing a more realistic eye and rain bands and also helps to improve the intensity forecast for the hurricane.

Further 4DVAR experiments are performed on mesoscale convective systems (MCSs). Detailed results and related issues will be presented during the conference.

Author

Mesoscale Phenomena; Trmm Satellite; Numerical Weather Forecasting; Data Acquisition; Microwave Imagery

20030053448 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Unusual Southern Hemisphere Stratosphere Winter of 2002

Newman, Paul A.; Nash, Eric R.; [April 1, 2003]; 33 pp.; In English; Original contains color illustrations; Copyright; Avail: CASI; [A03](#), Hardcopy

The southern hemisphere stratospheric winter of 2002 was the most unusual winter yet observed in the southern hemisphere climate record. Temperatures near the edge of the Antarctic polar vortex were considerably warmer than normal over the entire course of the winter. The polar night jet was considerably weaker than normal, and was displaced more poleward than has been observed in previous winters. These record high temperatures and weak jet resulted from a series of wave events that took place over the course of the winter. The first large event occurred on 15 May, and the final warming occurred on 25 October. The propagation of these wave events from the troposphere is diagnosed from time series of Eliassen-Palm flux vectors. The wave events tended to occur irregularly over the course of the winter, and pre-conditioned the polar night jet for the extremely large wave event of 22 September. This large wave event resulted in the first ever observed major stratospheric warming in the southern hemisphere. This wave event split the Antarctic ozone hole. The combined effect of the wave events of the 2002 winter resulted in the smallest ozone hole observed since 1988.

Author

Antarctic Regions; Winter; Stratospheric Warming; Ozone Depletion; Climate

20030053455 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Application of Hilbert-Huang Transforms to Meteorological Datasets

Duffy, Dean G.; [April 2003]; 30 pp.; In English; Original contains color illustrations; No Copyright; Avail: CASI

Recently a new spectral technique has been developed for the analysis of aperiodic and nonlinear signals - the Hilbert-Huang transform. This paper shows how these transforms can be used to discover synoptic and climatic features: For sea level data, the transforms capture the oceanic tides as well as large, aperiodic river outflows. In the case of solar radiation, we observe variations in the diurnal and seasonal cycles. Finally, from barographic data, the Hilbert-Huang transform reveals the passage of extratropical cyclones, fronts, and troughs. Thus, this technique can flag significant weather events such as a flood or the passage of a squall line.

Author

Hilbert Transformation; Climatology; Oceanography; Meteorology; Data Acquisition

20030053456 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Infrared Aerosol Radiative Forcing at the Surface and the Top of the Atmosphere

Markowicz, Krzysztof M.; Flatau, Piotr J.; Vogelmann, Andrew M.; Quinn, Patricia K.; Welton, Ellsworth J.; [April 15, 2003]; 26 pp.; In English; Original contains poor quality, truncated or crooked pages; Copyright; Avail: CASI; [A03](#), Hardcopy

We study the clear-sky aerosol radiative forcing at infrared wavelengths using data from the Aerosol Characterization Experiment (ACE-Asia) cruise of the NOAA R/V Ronald H. Brown. Limited number of data points is analyzed mostly from ship and collocated satellite values. An optical model is derived from chemical measurements, lidar profiles, and visible extinction measurements which is used to estimate the infrared aerosol optical thickness and the single scattering albedo. The IR model results are compared to detailed Fourier Transform Interferometer based infrared aerosol forcing estimates, pyrogeometer based infrared downward fluxes, and against the direct solar forcing observations. This combined approach attests for the self-consistency of the optical model and allows to derive quantities such as the infrared forcing at the top of the atmosphere or the infrared optical thickness. The mean infrared aerosol optical thickness at 10 microns is 0.08 and the single scattering albedo is 0.55. The modeled infrared aerosol forcing reaches 10 W/sq m during the cruise, which is a significant contribution to the total direct aerosol forcing. The surface infrared aerosol radiative forcing is between 10 to 25% of the shortwave aerosol forcing. The infrared aerosol forcing at the top of the atmosphere can go up to 19% of the solar aerosol forcing. We show good agreement between satellite (CERES instrument) retrievals and model results at the top of the atmosphere. Over the Sea of Japan, the average infrared radiative forcing is 4.6 W/sq m in the window region at the surface and it is 1.5 W/sq m at top of the atmosphere. The top of the atmosphere IR forcing efficiency is a strong function of aerosol

temperature while the surface IR forcing efficiency varies between 37 and 55 W/sq m (per infrared optical depth unit). and changes between 10 to 18 W/sq m (per infrared optical depth unit).

Author

Infrared Radiation; Aerosols; Radiance; Optical Thickness; Scattering; Albedo; Flux; Solar Flux; Upper Atmosphere

20030054350 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Influence of Ice-phase of Hydrometeors on Moist-Convection

Sud, Y. C.; Walker, G. K.; [2003]; 4 pp.; In English; Copyright; Avail: CASI; [A01](#), Hardcopy

Climate models often ignore the influence of ice-phase physics (IPP) of hydrometeors as a second order effect. This has also been true for McRAS (Microphysics of clouds with Relaxed Arakawa Schubert Scheme) developed by the authors. Recognizing that the temperature sounding is critical for moist-convection, and, that IPP would modify it, we investigated the influence of introducing IPP into McRAS coupled to FvGCM (finite volume General Circulation Model with NCAR physics). We analyzed three 3-yr long simulations; the first called Control Case, CC and had no IPP; the other two called Experiments E1 and E2 had IPP introduced with two different in-cloud freezing assumptions. Simulation E1 assumed that all hydrometeors remain liquid in the updraft and freeze upon detrainment. Simulation E2 invoked the in-cloud freezing of new condensate generated at subfreezing temperatures in the updraft while old cloud water continued to ascend as liquid. Upon detrainment, this cloud water also froze like in E1. With these assumptions, about 50% of hydrometeors froze in the tower and the rest froze in the anvil. However, in both E1 and E2, the frozen hydrometeors melted during fall at the first encounter of above freezing ambient temperature. Comparative analysis revealed that E1 simulated far more mid-level and far less deep clouds while E2 had modified deep and more mid-level clouds as compared to CC along with some major changes around the melt-level. We infer that IPP produced a more realistic response in E2. At the basic level, the results show that ice-phase processes influence convective detrainment at mid- and deep levels in accord with TOGAGOARE observations. The results suggest that IPP can help to mitigate less-than-observed mid-level and over-abundance of deep convective clouds in McRAS.

Author

Ice; Hydrometeors; Moisture; Convection; Atmospheric General Circulation Models

20030054352 NASA Goddard Space Flight Center, Greenbelt, MD, USA

ENSO Variations in Tropical Precipitation

Curtis, Scott; Adler, Robert; [2002]; 1 pp.; In English; International TRMM Science Conference, 22-26 Jul. 2002, Honolulu, HI, USA; No Copyright; Avail: Other Sources; Abstract Only

TRMM was launched during the height of the 1997-98 El Nino and offered new insights into the evolution of precipitation during this event. The rapid decline of the El Nino in May 1998 was followed by a long lasting La Nina. Extreme wet and dry regions in the tropics during this El Nino/Southern Oscillation (ENSO) cycle will be compared with the previous 23 years using the Global Precipitation Climatology Project (GPCP) products. In particular, patterns of precipitation anomalies preceding El Nino will be examined. It has been shown that 30-60 day oscillations in convection appear in the western Pacific before the onset of El Nino. Also, a fast traveling equatorial wave of rainfall circled the globe during the demise of 1997-98 El Nino. Recent work has revealed an interesting relationship between a gradient of anomalous precipitation in the eastern Indian Ocean and the initiation of El Nino. This link will be explored as well as other anomaly patterns in 2002, which may signal an upcoming El Nino.

Author

El Nino; Periodic Variations; Trmm Satellite; Rain

20030054355 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Hurricane Erin September 10, 2001: Comparison of TRMM, AMSU-A and QUIKSCAT Data with an Extensive Aircraft Data Set, and Some Preliminary Results

Simpson, J.; Halverson, J.; Rosenfeld, D.; Hudson, J.; [2002]; 1 pp.; In English; TRMM International Science Conference, 22-26 Jul. 2002, Honolulu, HI, USA; Copyright; Avail: Other Sources; Abstract Only

A main purpose of this study is to compare satellite products from TRMM, AMSU-A and QuikSCAT with a unique, extensive aircraft data set in Category 3 Hurricane Erin on September 10, 2001, and to draw some preliminary conclusions from the data. For the first time, dropwindsondes were obtained by the NASA ER-2 aircraft. There were 8 soundings in the eye, core and surroundings radially out to the edge of the Central Dense Overcast (CDO). Additionally, 11 dropwindsondes from the DC-8 aircraft at about 12 km documented the storm outskirts and environment. TRMM made a direct overpass of the eye as did both NOAA-15 and NOM-16 with AMSU on board. Among the most interesting results: Contours of the tropopause

height (a first). As expected from earlier fragmentary results, the tropopause was approximately 1 km higher in the core than in the environment. The highest tropopause was about 2 km above the tallest towers in the eyewall, south-southeast of the eye center, suggesting that earlier convective towers had been higher than those measured by EDOP and TRMM during the flights. Surprisingly, the heaviest precipitation was on the opposite side of the eyewall from the tallest convective towers. The warm core was elongated in the vertical, and poorly retrieved from the AMSU-A data by the NESDIS profile retrieval algorithm. The eye of Erin was 'dirty'. A CCN/CN counter flown on the NOAA P3 at 14.3 km showed a concentration of 1500 aerosol particles per cubic centimeter. This is an order of magnitude higher than a sample in the hurricane environment. TRMM data are used to hypothesize an explanation.

Author

Hurricanes; Noaa Satellites; Data Acquisition; Trmm Satellite; Advanced Microwave Sounding Unit; U-2 Aircraft

20030054358 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Meteorology, Macrophysics, Microphysics, Microwaves, and Mesoscale Modeling of Mediterranean Mountain Storms: The M8 Laboratory

Starr, David O., Technical Monitor; Smith, Eric A.; [2002]; 1 pp.; In English; Noel LaSeur Symposium, Jun. 7, 2002, Tallahassee, FL, USA; No Copyright; Avail: Other Sources; Abstract Only

Comprehensive understanding of the microphysical nature of Mediterranean storms can be accomplished by a combination of in situ meteorological data analysis and radar-passive microwave data analysis, effectively integrated with numerical modeling studies at various scales, from synoptic scale down through the mesoscale, the cloud macrophysical scale, and ultimately the cloud microphysical scale. The microphysical properties of and their controls on severe storms are intrinsically related to meteorological processes under which storms have evolved, processes which eventually select and control the dominant microphysical properties themselves. This involves intense convective development, stratiform decay, orographic lifting, and sloped frontal lifting processes, as well as the associated vertical motions and thermodynamical instabilities governing physical processes that affect details of the size distributions and fall rates of the various types of hydrometeors found within the storm environment. Insofar as hazardous Mediterranean storms, highlighted in this study by three mountain storms producing damaging floods in northern Italy between 1992 and 2000, developing a comprehensive microphysical interpretation requires an understanding of the multiple phases of storm evolution and the heterogeneous nature of precipitation fields within a storm domain. This involves convective development, stratiform transition and decay, orographic lifting, and sloped frontal lifting processes. This also involves vertical motions and thermodynamical instabilities governing physical processes that determine details of the liquid/ice water contents, size distributions, and fall rates of the various modes of hydrometeors found within hazardous storm environments.

Author

Mesoscale Phenomena; Atmospheric Models; Mediterranean Sea; Storms (Meteorology); Hydrometeors; Mountains

20030054361 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Interannual Variability of Ozone in the Polar Vortex during the Fall Season

Bhartia, P. K., Technical Monitor; Kawa, S. R.; Newman, P. A.; Schoeberl, M. R.; Stolarski, R. S.; Bevilacqua, R.; [2002]; 1 pp.; In English; AMS 12th Conference on Middle Atmosphere, 4-8 Nov. 2002, San Antonio, TX, USA; No Copyright; Avail: Other Sources; Abstract Only

Previous analysis has shown that the distribution of O3 at high northern latitudes in the lower-to-middle stratosphere at the beginning of the winter season has a characteristic distribution, which is consistent between in situ and satellite measurements. Initial O3 profiles in the vortex are similar to each other and are quite different from outside the vortex at the same latitude and also from a zonal mean climatology. In the vortex, O3 is nearly constant from 500 to above 800 K with a value near 3 ppmv. Values outside the vortex are up to a factor of 2 higher and increase significantly with potential temperature. Model analysis indicates that the characteristic vortex O3 profiles arise from a combination of seasonally accelerated photochemical loss at high latitudes and minimal transport of air from lower latitudes. Analysis of the relatively high-resolution POAM data shows that these characteristic O3 distributions are consistent from year to year and between the hemispheres. Here we emphasize analysis of the 24-year time series of O3 data from SBUV in the lower-to-middle stratosphere at high latitudes in the fall vortex. We find that the variability of O3 from SBUV is relatively small in this regime and no significant trend is detectable. The implications of the findings for stratospheric O3 chemistry and transport will be explored.

Author

Ozone; Annual Variations; Polar Regions; Vortices; Climate Models; Air Land Interactions

20030054363 NASA Goddard Space Flight Center, Greenbelt, MD, USA

High-Resolution Simulation of Hurricane Bonnie (1998): Microphysics Validation using TRMM Data

Starr, David OC., Technical Monitor; Braun, Scott A.; Olson, Bill; Pu, Zhaoxia; [2002]; 1 pp.; In English; International TRMM Science Conference, 22-26 Jul. 2002, Honolulu, HI, USA; Copyright; Avail: Other Sources; Abstract Only

A simulation of Hurricane Bonnie (1998) has been performed using multiple grid nesting to 2 km grid spacing. The simulation is initialized with large-scale analysis fields from the European Center for Medium Range Forecasts and with a bogus vortex inserted via four-dimensional variational data assimilation. The simulation reproduces well the storm intensity, the wavenumber 1 asymmetry of the precipitation field, the occurrence of deep convective towers within the eyewall, and the presence of broad stratiform precipitation regions. Radar and microwave observations from TRMM are used to validate the simulation. Result show excessive graupel production and, to some extent, excessive precipitation production in general by the model. Additional simulations are conducted (and validated by TRMM data) to test parameters and assumptions within the microphysics parameterizations including particle size distributions, particle densities, and assumptions that impact the partitioning of precipitation mass between graupel and snow.

Author

High Resolution; Simulation; Hurricanes; Computational Grids; Graupel; Particle Size Distribution

20030054365 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Effect of Transport and Circulation Differences on Stratospheric Ozone Recovery in Two 35-year Three-dimensional Simulations

Bhartia, P. K., Technical Monitor; Strahan, Susan; Douglass, Anne; [2002]; 1 pp.; In English; AMS 12th Conference on the Middle Atmosphere, 4-8 Nov. 2002, San Antonio, TX, USA; No Copyright; Avail: Other Sources; Abstract Only

The NASA Global Modeling Initiative (GMI) has completed two 35-year simulations with WMO future baseline boundary conditions that simulate increasing N₂O and CH₄ emissions and decreasing organic chlorine and bromine emissions. Simulations were done with the GMI offline chemistry and transport model using 1) 1 year of winds from the Finite-Volume General Circulation Model (FV-GCM), repeated for the 35 years, and 2) 1 year of winds from the Finite-Volume Data Assimilation System (FV-DAS), repeated for 35-years. The simulations have full stratospheric chemistry. To understand differences in simulated ozone recoveries, basic transport and circulation differences between these models are evaluated. The distribution of mean age of stratospheric air in the FV-GCM run agrees well with observations in the lower stratosphere but the FV-DAS ages are generally too low. This implies circulation and mixing differences that will affect the distributions of other trace species such as CH₄, NO, and the organic halogens, all of which are responding to changing boundary conditions and are involved in ozone loss. Realism of model transport is evaluated, with particular attention given to regions and seasons where ozone recovery is expected. Preliminary results indicate increasing ozone trends in the lowermost stratosphere in summer and in the Antarctic and Arctic lower stratosphere in winter and spring.

Author

Atmospheric General Circulation Models; Atmospheric Circulation; Stratosphere; Ozone; Three Dimensional Models; Emission; Atmospheric Chemistry

20030054383 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Characteristics of Vertical Profiles of Reflectivity and Doppler Derived From TRMM Field Campaigns

Starr, David OC., Technical Monitor; Heymsfield, G.; Belcher, L.; Tian, L.; [2002]; 1 pp.; In English; International TRMM Science Conference, 22-26 Jul. 2002, Honolulu, HI, USA; Copyright; Avail: Other Sources; Abstract Only

The TRMM Precipitation Radar (PR) measures the vertical profile of reflectivity from which the surface rain rate is estimated after attenuation corrections in the 2A21 algorithm. Characteristics of the vertical reflectivity profile is important for various reasons ranging from scientific to instrument algorithms. It is well known that different types of precipitation such as stratiform or convection, have different heating profiles. The vertical profile of reflectivity can provide information on precipitation classification. The vertical reflectivity structure also provides information on precipitation processes such as growth and aggregation. In terms of TRMM algorithms, an independent estimate of the vertical profiles are also extremely important since the PR returns can be attenuated in the rain layer near the surface. Corrections for attenuation are required in the lowest few kilometers, necessitating some assumptions about the rain size distributions and the reflectivity profile below the lowest measurement unaffected by the surface return. Furthermore, some assumptions about the vertical reflectivity profile are required for Ground Validation (GV) radars, since their lowest scan may be 1 or more kilometers above the surface. Statistics on the vertical reflectivity and Doppler structure are presented from the ER-2 Doppler Radar (EDOP) which participated in several TRMM field campaigns (TEFLUN-A, TEFLUN-B, and LBA) and CAMEX-3. The ER-2 aircraft overflew diverse precipitation types during these campaigns. EDOP is an X-band (9.6 GHz) radar for which returns are less

attenuated than at the TRMM PR frequency. The EDOP profiles are first corrected for attenuation using the SRT method. The data from all the ER-2 campaigns are then classified by type (convection, stratiform, and other) and then statistics were performed on the vertical reflectivity and Doppler profiles in the form of CFAD's. These CFADs are compared and discussed. The computed CFAD's indicate significant differences as a function of precipitation type and location (hurricane versus non-hurricane, Brazil versus Florida). The implications of these profiles will be discussed.

Author

Algorithms; Trmm Satellite; Vertical Distribution; Meteorological Radar; Reflectance; Doppler Radar

20030054385 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Cloud-Resolving Model Simulations of LBA Convective Systems: Easterly and Westerly Regimes

Lang, Stephen E.; Tao, Wei-Kuo; [2002]; 1 pp.; In English; International TRMM Science Conference, 22-26 Jul. 2002, Honolulu, HI, USA; No Copyright; Avail: Other Sources; Abstract Only

The 3D Goddard Cumulus Ensemble (GCE) model was used to simulate convection that occurred during the TRMM LBA field experiment in Brazil. Convection in this region can be categorized into two different regimes. Low-level easterly flow results in moderate to high CAPE and a drier environment. Convection is more intense like that seen over continents. Low-level westerly flow results in low CAPE and a moist environment. Convection is weaker and more widespread characteristic of oceanic or monsoon-like systems. The GCE model has been used to study both regimes in order to provide cloud data sets that are representative of both environments in support of TRMM rainfall and heating algorithm development. Two different case are presented: Jan 26,1999, an easterly regime case, and Feb 23,1999, a westerly regime case. The Jan 26 case is an organized squall line and is initialized with a standard cold pool. The sensitivity to mid-level sounding moisture and wind shear will also be shown. The Feb 23 case is less-organized with only transient lines and is initialized with either warm bubbles or prescribed surface fluxes. Heating profiles, rainfall statistics and storm characteristics are compared and validated for the two cases against observations collected during the experiment.

Author

Three Dimensional Models; Convection; Cumulus Clouds; Wind Shear; Simulation

20030054394 NASA Goddard Space Flight Center, Greenbelt, MD, USA

What Controls the Size of the Antarctic Ozone Hole?

Bhartia, P. K., Technical Monitor; Newman, Paul A.; Kawa, S. Randolph; Nash, Eric R.; [2002]; 1 pp.; In English; AMS Meeting, 4-7 November 2002, San Antonio, TX, USA; No Copyright; Avail: Other Sources; Abstract Only

The Antarctic ozone hole is a region of extremely large ozone depletion that is roughly centered over the South Pole. Since 1979, the area coverage of the ozone hole has grown from near zero size to over 24 Million square kilometers. In the 8-year period from 1981 to 1989, the area expanded by 18 Million square kilometers. During the last 5 years, the hole has been observed to exceed 25 Million square kilometers over brief periods. We will review these size observations, the size trends, and the interannual variability of the size. The area is derived from the area enclosed by the 220 DU total ozone contour. We will discuss the rationale for the choice of 220 DU: 1) it is located near the steep gradient between southern mid-latitudes and the polar region, and 2) 220 DU is a value that is lower than the pre- 1979 ozone observations over Antarctica during the spring period. The phenomenal growth of the ozone hole was directly caused by the increases of chlorine and bromine compounds in the stratosphere. In this talk, we will show the relationship of the ozone hole's size to the interannual variability of Antarctic spring temperatures. In addition, we will show the relationship of these same temperatures to planetary-scale wave forcings.

Author

Antarctic Regions; Ozone Depletion; Annual Variations; Atmospheric Temperature

20030054395 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The 1996-2002 Plunge in the North-Atlantic Oscillation Index Produces Cold Spring Temperatures in Central Europe

Atlas, Robert, Technical Monitor; Otterman, Joseph; Atlas, Robert; Bungato, Dennis; Chou, Shu-Hsien; Koslowsky, Dirk; Rogers, Jeffrey; Wos, Alojzy; September 11, 2002; 4 pp.; In English; European Conference on Applied Climatology, November 2002, Brussels, Belgium; Copyright; Avail: CASI; A01, Hardcopy

Surface-air temperatures in winter and spring in central Europe rose over the second half of the 20th century, reported for different data-spans, and by different approaches (Ross et al., 1996; Angell, 1999; Hansen et al., 1999; Demaree et al., 2002). Analysis with a finer temporal resolution shows that late-winter and early-spring (February and March) trends are much stronger than the 3-month season averages (Otterman et al., 2002a). Responding to this need for finer than 3- month resolution, observations at meteorological stations in central Europe are analyzed here for the years 1951-2002, computing six-pentad

(5-day period) averages (effectively monthly averages for January, February, and March). The daily minimum surface-air temperature, $T(\text{sub min})$, and the daily maximum temperature, $T(\text{sub max})$, rose steeply in Berlin and Poznan' in the years 1951-1995. Based on sensitivity studies, the bulk of this sharp warming is due to stronger southwesterlies over the North Atlantic, with which the temperatures in Europe are strongly correlated (Otterman et al., 1999; 2002a). However, for the most recent seven years, a pronounced downturn of the warming is observed, which we attribute to the concurrent, 1996-2002, sharp downturn of the ocean-surface southwesterlies over the North Atlantic (Otterman et al., 2002b). Such changes in the ocean winds and variations in the storm tracks are associated with changes in the North Atlantic Oscillation, NAO (Rogers, 1997). The NAO index, the difference in the surface pressure between Iceland and Azores, constitutes a measure of the zonal winds over the eastern North Atlantic, and thus is a critically important factor influencing the flow of maritime air into Europe (but the temperature of the advected airmasses depends on the meridional component, as we discuss). The recent (1996-2002) downturn in this index resulted in much colder spring temperatures in Europe, with adverse significance for the growing season.

Author

Central Europe; Oscillations; Annual Variations; Atmospheric Temperature; Climatology; Spring (Season); Cold Weather

20030054396 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Advances in Data Assimilation and Weather Prediction Using TRMM Observations

Atlas, Robert, Technical Monitor; Hou, Arthur Y.; Zhang, Sara; daSilva, Arlindo; Li, Jui-Lin; Zhang, Minghua; [2002]; 1 pp.; In English; International Tropical Rainfall Measuring Mission (TRMM) Science Conference, 22-26 Jul. 2002, Honolulu, HI, USA; Copyright; Avail: Other Sources; Abstract Only

Understanding the Earth's climate and how it responds to climate perturbations requires knowledge of how atmospheric moisture, clouds, latent heating, the large-scale circulation and energy fluxes vary with changing climatic conditions. The physical process linking these climate elements is precipitation. Accurate knowledge of how precipitation varies in space and time and how it couples with other atmospheric variables is essential for understanding the global water and energy cycle. In recent years, TRMM data products have played a key role in advancing the field of data assimilation to provide better global analyses for climate research and numerical weather prediction. TRMM research has demonstrated the effectiveness of microwave-based rainfall and total precipitable water (TPW) observations in improving the quality of assimilated datasets and upgrading forecast skills. TRMM latent heating products have also stimulated experimentation with innovative techniques to use this type of information to improve global analyses. We discuss strategies of assimilating TRMM observations at NASA's Data Assimilation Office and present results on the impact assimilating TRMM data on the Goddard Earth Observing System (GEOS) analyses and forecast capabilities.

Author

Trmm Satellite; Weather Forecasting; Climatology; Precipitation (Meteorology); Perturbation; Data Acquisition

20030054406 Maryland Univ. Baltimore County, Catonsville, MD, USA

Effects of Volcanic Eruptions on Stratospheric Ozone Recovery

Rosenfield, Joan E.; [2002]; 1 pp.; In English; AMS, 4-7 Nov. 2002, San Antonio, TX, USA; Copyright; Avail: Other Sources; Abstract Only

The effects of the stratospheric sulfate aerosol layer associated with the Mt. Pinatubo volcano and future volcanic eruptions on the recovery of the ozone layer is studied with an interactive two-dimensional photochemical model. The time varying chlorine loading and the stratospheric cooling due to increasing carbon dioxide have been taken into account. The computed ozone and temperature changes associated with the Mt. Pinatubo eruption in 1991 agree well with observations. Long model runs out to the year 2050 have been carried out, in which volcanoes having the characteristics of the Mount Pinatubo volcano were erupted in the model at 10-year intervals starting in the year 2010. Compared to a non-volcanic run using background aerosol loading, transient reductions of globally averaged column ozone of 2-3 percent were computed as a result of each of these eruptions, with the ozone recovering to that computed for the non-volcanic case in about 5 years after the eruption. Computed springtime Arctic column ozone losses of from 10 to 18 percent also recovered to the non-volcanic case within 5 years. These results suggest that the long-term recovery of ozone would not be strongly affected by infrequent volcanic eruptions with a sulfur loading approximating Mt. Pinatubo. Sensitivity studies in which the Arctic lower stratosphere was forced to be 4 K and 10 K colder resulted in transient ozone losses of which also recovered to the non-volcanic case in 5 years. A case in which a volcano five times Mt. Pinatubo was erupted in the year 2010 led to maximum springtime column ozone losses of 45 percent which took 10 years to recover to the background case. Finally, in order to simulate a situation in which frequent smaller volcanic eruptions result in increasing the background sulfate loading, a simulation was made in which

the background aerosol was increased by 10 percent per year. This resulted in a delay of the recovery of column ozone to 1980 values of more than 10 years.

Author

Volcanic Eruptions; Atmospheric Models; Stratosphere; Ozone; Sulfates; Aerosols; Photochemical Reactions; Two Dimensional Models

20030054555 NASA Marshall Space Flight Center, Huntsville, AL, USA

Use of Satellite Data Assimilation to Infer Land Surface Thermal Inertia

Lapenta, William; McNider, Richard T.; Biazar, Arastoo; Suggs, Ron; Jedlovec, Gary; Dembek, Scott; [2002]; 1 pp.; In English; AMS Conference on Interactions of the Sea and Atmosphere, 9-13 Feb. 2003, Long Beach, CA, USA; Copyright; Avail: Other Sources; Abstract Only

There are two important but observationally uncertain parameters in the grid averaged surface energy budgets of mesoscale models - surface moisture availability and thermal heat capacity. A technique has been successfully developed for assimilating Geostationary Operational Environmental Satellite (GOES) skin temperature tendencies during the mid-morning time frame to improve specification of surface moisture. In a new application of the technique, the use of satellite skin temperature tendencies in early evening is explored to improve specification of the surface thermal heat capacity. Together, these two satellite assimilation constraints have been shown to significantly improve the characterization of the surface energy budget of a mesoscale model on fine spatial scales. The GOES assimilation without the adjusted heat capacity was run operationally during the International H₂O Project on a 12-km grid. This paper presents the results obtained when using both the moisture availability and heat capacity retrievals in concert. Preliminary results indicate that retrieved moisture availability alone improved the verification statistics of 2-meter temperature and dew point forecasts. Results from the 1.5 month long study period using the bulk heat capacity will be presented at the meeting.

Author

Atmospheric Models; Energy Budgets; Data Integration; Heat Transfer; Moisture; Performance Prediction

20030055154 NASA Marshall Space Flight Center, Huntsville, AL, USA

Determination of Storm Flashing/Non-Flashing Condition From Convective and Environmental Observations

Boccippio, Dennis J.; [2002]; 1 pp.; In English; 2002 Fall American Geophysical Union Meeting, 6-10 Dec. 2002, San Francisco, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

A simple and fundamental problem in cloud electrification is whether or not a cloud can be determined to be producing lightning or not producing lightning, based solely on knowledge of its microphysical (and perhaps environmental) state. A merged database of TRMM radar, microwave and lightning observations and NCEP reanalysis environmental parameters is used to answer this question, for the tropics. The formal skill of traditional, univariate rule-based approaches (e.g., 35 dBZ occurrence at 6 km altitude) is quantified (via the probability of detection (POD), false alarm rate (FAR) and critical skill index (CSI)). Under indiscriminate application to the tropics, peak rule-based CSI for categorization of flashing storms is approximately 50%, with peak POD approximately 67% and minimum FAR approximately 33%, with peak CSI found for radar reflectivity-based parameters at 7-7.5 km altitude (near -15C). Separation of land and ocean domains yields approximately 5-10% gains in CSI over land. Conventional multivariate categorization techniques (discriminant analysis) are then applied, and less conventional (neural network) categorization techniques are also discussed.

Author

Thunderstorms; Cloud Physics; Atmospheric Electricity; Lightning; Multivariate Statistical Analysis

48

OCEANOGRAPHY

Includes the physical, chemical and biological aspects of oceans and seas; ocean dynamics; and marine resources. For related information see also 43 *Earth Resources and Remote Sensing*.

20030054517 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Nonlinear Internal Waves in the South China Sea during ASIAEX

Liu, Antony K.; Tang, David; Ramp, Steve; [2003]; 1 pp.; In English; Workshop on Internal Solutions and Their Impacts, 23-26 Jul. 2003, Williamsburg, VA, USA; Copyright; Avail: Other Sources; Abstract Only

Internal wave distribution maps have been compiled from more than one hundreds of ERS-1/2, RADARSAT and Space Shuttle SAR images in the South China Sea (SCS) from 1993 to 2000. Based on these distribution maps, most of internal

waves in the northeast part of SCS were propagating westward. The wave crest can be as long as 200 km with amplitude of 100 m, due to strong current from the Kuroshio branching out into the SCS. In recent Asian Seas International Acoustics Experiment (ASIAEX), moorings have been deployed in April 2000 and May 2001. Simultaneous RADARSAT ScanSAR images have been collected during the field test to integrate with the model and the in-situ measurements in the SCS. During ASIAEX in May 2001, many large internal waves were observed at the test area and were the major features for acoustic volume interaction. The environmental parameters have been calculated based on extensive CTD castings and mooring data. Nonlinear internal wave models have been applied to simulate the wave evolution on the continental shelf and the results compare reasonably with mooring measurements. The evolution and dissipation of huge internal waves on the shelf break, mode-two waves, elevation waves, and wave-wave interaction are very important issues for acoustic propagation. The implication of internal wave effects on acoustic propagation will also be discussed.

Author

Acoustic Propagation; Wave Interaction; Nonlinearity; Radar Imagery; Radarsat; Continental Shelves; Acoustics

55

EXO BIOLOGY

Includes astrobiology; planetary biology; and extraterrestrial life. For the biological effects of aerospace environments on humans see *52 Aerospace Medicine*; on animals and plants see *51 Life Sciences*. For psychological and behavioral effects of aerospace environments see *53 Behavioral Sciences*.

20030053144 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The First Cell Membranes

Vondrak, Richard R., Technical Monitor; Demner, David; Dworkin, Jason P.; Sandford, Scott A.; Bernstein, Max P.; Allamandola, Louis J.; [2002]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Organic compounds are synthesized in the interstellar medium and can be delivered to planetary surfaces such as the early Earth, where they mix with endogenous organic mixtures. Some of these compounds are amphiphilic, having polar and non-polar groups on the same molecule. Amphiphilic compounds spontaneously self-assemble into more complex structures such as bimolecular layers, which in turn form closed membranous vesicles. The first forms of cellular life required self-assembled membranes that were likely to be available on the prebiotic Earth. Laboratory simulations show that such vesicles readily encapsulate functional macromolecules, including nucleic acids and polymerases. A goal of future investigations is to fabricate artificial cells as models of the origin of life.

Author

Biological Evolution; Macromolecules; Cell Membranes (Biology); Organic Compounds; Exobiology

20030054531 California Inst. of Tech., Pasadena, CA, USA

Spectroscopic Studies of Pre-Biotic Carbon Chemistry

Blake, Geoffrey A.; [2003]; 10 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NAG5-11488; No Copyright; Avail: CASI; [A02](#), Hardcopy

As described in the original proposal and in our progress reports, research in the Blake group supported by the Exobiology program seeks to understand the pre-biotic chemistry of carbon along with that of other first- and second-row elements from the earliest stages of star formation through the development of planetary systems. The major tool used is spectroscopy, and the program has observational, laboratory, and theoretical components. The observational and theoretical programs are concerned primarily with a quantitative assessment of the chemical budgets of the biogenic elements in the circumstellar environment of forming stars and planetary systems, while the laboratory work is focused on the complex species that characterize the pre-biotic chemistry of carbon. We outline below our results over the past year acquired, in part, with Exobiology support.

Derived from text

Exobiology; Carbon; Star Formation; Abiogenesis

MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

Includes general topics and overviews related to mathematics and computer science. For specific topics in these areas see *categories 60 through 67*.

20030054478 NASA Ames Research Center, Moffett Field, CA, USA

Accelerating Large Data Analysis By Exploiting Regularities

Moran, Patrick J.; Ellsworth, David; April 07, 2003; 8 pp.; In English

Contract(s)/Grant(s): DTTS59-99-D099437; NASA Order A-61812-D; RTOP 704-42-22; No Copyright; Avail: CASI; [A02](#), Hardcopy

We present techniques for discovering and exploiting regularity in large curvilinear data sets. The data can be based on a single mesh or a mesh composed of multiple submeshes (also known as zones). Multi-zone data are typical to Computational Fluid Dynamics (CFD) simulations. Regularities include axis-aligned rectilinear and cylindrical meshes as well as cases where one zone is equivalent to a rigid-body transformation of another. Our algorithms can also discover rigid-body motion of meshes in time-series data. Next, we describe a data model where we can utilize the results from the discovery process in order to accelerate large data visualizations. Where possible, we replace general curvilinear zones with rectilinear or cylindrical zones. In rigid-body motion cases we replace a time-series of meshes with a transformed mesh object where a reference mesh is dynamically transformed based on a given time value in order to satisfy geometry requests, on demand. The data model enables us to make these substitutions and dynamic transformations transparently with respect to the visualization algorithms. We present results with large data sets where we combine our mesh replacement and transformation techniques with out-of-core paging in order to achieve significant speed-ups in analysis.

Author

Regularity; Grid Generation (Mathematics); Rigid Structures; Cylindrical Bodies; Algorithms; Computational Grids

20030054481 Research Inst. for Advanced Computer Science, Moffett Field, CA, USA

On the Critical Behaviour, Crossover Point and Complexity of the Exact Cover Problem

Morris, Robin D.; Smelyanskiy, Vadim N.; Shumow, Daniel; Koga, Dennis, Technical Monitor; April 10, 2003; 12 pp.; In English; Constraint Programming 2003, 29 Sep. - 3 Oct. 2003, Kinsale, Ireland

Contract(s)/Grant(s): RTOP 749-40-00; Copyright; Avail: CASI; [A03](#), Hardcopy

Research into quantum algorithms for NP-complete problems has rekindled interest in the detailed study a broad class of combinatorial problems. A recent paper applied the quantum adiabatic evolution algorithm to the Exact Cover problem for 3-sets (EC3), and provided an empirical evidence that the algorithm was polynomial. In this paper we provide a detailed study of the characteristics of the exact cover problem. We present the annealing approximation applied to EC3, which gives an over-estimate of the phase transition point. We also identify empirically the phase transition point. We also study the complexity of two classical algorithms on this problem: Davis-Putnam and Simulated Annealing. For these algorithms, EC3 is significantly easier than 3-SAT.

Author

Combinatorial Analysis; Algorithms; Phase Transformations; Critical Point

COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware and data processing. For components see *33 Electronics and Electrical Engineering*. For computer vision see *63 Cybernetics, Artificial Intelligence and Robotics*.

20030054496 NASA Ames Research Center, Moffett Field, CA, USA

High End Computing Technologies for Earth Science Applications: Trends, Challenges, and Innovations

Parks, John, Technical Monitor; Biswas, Rupak; Yan, Jerry C.; Brooks, Walter F.; Sterling, Thomas L.; [2003]; 24 pp.; In English; Original contains black and white illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

Earth science applications of the future will stress the capabilities of even the highest performance supercomputers in the areas of raw compute power, mass storage management, and software environments. These NASA mission critical problems demand usable multi-petaflops and exabyte-scale systems to fully realize their science goals. With an exciting vision of the technologies needed, NASA has established a comprehensive program of advanced research in computer architecture, software tools, and device technology to ensure that, in partnership with US industry, it can meet these demanding

requirements with reliable, cost effective, and usable ultra-scale systems. NASA will exploit, explore, and influence emerging high end computing architectures and technologies to accelerate the next generation of engineering, operations, and discovery processes for NASA Enterprises. This article captures this vision and describes the concepts, accomplishments, and the potential payoff of the key thrusts that will help meet the computational challenges in Earth science applications.

Author

Supercomputers; Earth Sciences; NASA Programs; Research

61

COMPUTER PROGRAMMING AND SOFTWARE

Includes software engineering, computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM. For computer software applied to specific applications, see also the associated category.

20030053130 NASA Goddard Space Flight Center, Greenbelt, MD, USA

CCSDS File Delivery Protocol (CFDP): Why it's Useful and How it Works

Ray, Tim; [2003]; 1 pp.; In English; Space Internet Workshop, Jun. 2003, Cleveland, OH, USA; No Copyright; Avail: Other Sources; Abstract Only

Reliable delivery of data products is often required across space links. For example, a NASA mission will require reliable delivery of images produced by an on-board detector. Many missions have their own (unique) way of accomplishing this, requiring custom software. Many missions also require manual operations (e.g. the telemetry receiver software keeps track of what data is missing, and a person manually inputs the appropriate commands to request retransmissions). The Consultative Committee for Space Data Systems (CCSDS) developed the CCSDS File Delivery Protocol (CFDP) specifically for this situation. CFDP is an international standard communication protocol that provides reliable delivery of data products. It is designed for use across space links. It will work well if run over the widely used CCSDS Telemetry and Telecommand protocols. However, it can be run over any protocol, and will work well as long as the underlying protocol delivers a reasonable portion of the data. The CFDP receiver will autonomously determine what data is missing, and request retransmissions as needed. The CFDP sender will autonomously perform the requested transmissions. When the entire data product is delivered, the CFDP receiver will let the CFDP sender know that the transaction has completed successfully. The result is that custom software becomes standard, and manual operations become autonomous. This paper will consider various ways of achieving reliable file delivery, explain why CFDP is the optimal choice for use over space links, explain how the core protocol works, and give some guidance on how to best utilize CFDP within various mission scenarios. It will also touch on additional features of CFDP, as well as other uses for CFDP (e.g. the loading of on-board memory and tables).

Author

Protocol (Computers); Data Links; Wireless Communication; Data Transfer (Computers); Data Systems

20030054364 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Commanding Constellations (Pipeline Architecture)

Ray, Tim; Condrón, Jeff; [2003]; 4 pp.; In English; Space Mission Challenges for Information Technology, Jul. 2003, Pasadena, CA, USA; Copyright; Avail: CASI; [A01](#), Hardcopy

Providing ground command software for constellations of spacecraft is a challenging problem. Reliable command delivery requires a feedback loop; for a constellation there will likely be an independent feedback loop for each constellation member. Each command must be sent via the proper Ground Station, which may change from one contact to the next (and may be different for different members). Dynamic configuration of the ground command software is usually required (e.g. directives to configure each member's feedback loop and assign the appropriate Ground Station). For testing purposes, there must be a way to insert command data at any level in the protocol stack. The Pipeline architecture described in this paper can support all these capabilities with a sequence of software modules (the pipeline), and a single self-identifying message format (for all types of command data and configuration directives). The Pipeline architecture is quite simple, yet it can solve some complex problems. The resulting solutions are conceptually simple, and therefore, reliable. They are also modular, and therefore, easy to distribute and extend. We first used the Pipeline architecture to design a CCSDS (Consultative Committee for Space Data Systems) Ground Telecommand system (to command one spacecraft at a time with a fixed Ground Station interface). This pipeline was later extended to include gateways to any of several Ground Stations. The resulting pipeline was then extended to handle a small constellation of spacecraft. The use of the Pipeline architecture allowed us to easily handle the increasing complexity. This paper will describe the Pipeline architecture, show how it was used to solve each of the above

commanding situations, and how it can easily be extended to handle larger constellations.

Author

Architecture (Computers); Computer Systems Design; Command And Control; Pipelining (Computers); Message Processing; Interprocessor Communication

20030054474 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Oversight and Development of a Community Monte Carlo Radiative Transfer Model

[2003]; 3 pp.; In English

Contract(s)/Grant(s): NAG5-11279; No Copyright; Avail: CASI; [A01](#), Hardcopy

Under this grant we have developed a Monte Carlo radiative transfer code that will act as the nucleus for the 13RC Community Monte Carlo Model. All code is written in ANSI-compliant Fortran-95. Many modules define public type and procedures to manipulate them, but do not allow access to the type's internal components. This allows each module to do its own exhaustive error checking up-front, then proceed in a streamlined way. Many modules can read and write the state of their objects to persistent files. The code has been tested on a Macintosh running OS 10.2.4 and the Absoft Fortran compiler, and on Sun UltraSparcs running Solaris 5.8 and Forte V8 compilers. The code exposed bugs in the Intel Fortran Compiler (ifc) on the 13RC Linux host, and we are waiting for a resolution of these bugs before finished the port. the code base is under CVS versions control. The code base consists of the core code (nine modules providing the infrastructure), example integrators, and a suite of utilities and examples.

Author

Applications Programs (Computers); Coding; Atmospheric Models; Mathematical Models; Operating Systems (Computers)

20030054482 NASA Ames Research Center, Moffett Field, CA, USA

A Hybrid Constraint Representation and Reasoning Framework

Golden, Keith; Pang, Wan-Lin; April 15, 2003; 16 pp.; In English; Constant Programming 2003, 9 Sep. 2003, Kinsale, Ireland; No Copyright; Avail: CASI; [A03](#), Hardcopy

This paper introduces JNET, a novel constraint representation and reasoning framework that supports procedural constraints and constraint attachments, providing a flexible way of integrating the constraint reasoner with a run- time software environment. Attachments in JNET are constraints over arbitrary Java objects, which are defined using Java code, at runtime, with no changes to the JNET source code.

Author

Computer Programs; Java (Programming Language); Software Development Tools

20030054493 NASA Ames Research Center, Moffett Field, CA, USA

Design for Verification: Using Design Patterns to Build Reliable Systems

Mehlitz, Peter C.; Penix, John; Koga, Dennis, Technical Monitor; April 08, 2003; 4 pp.; In English

Contract(s)/Grant(s): NAS2-00065; No Copyright; Avail: CASI; [A01](#), Hardcopy

Components so far have been mainly used in commercial software development to reduce time to market. While some effort has been spent on formal aspects of components, most of this was done in the context of programming language or operating system framework integration. As a consequence, increased reliability of composed systems is mainly regarded as a side effect of a more rigid testing of pre-fabricated components. In contrast to this, Design for Verification (D4V) puts the focus on component specific property guarantees, which are used to design systems with high reliability requirements. D4V components are domain specific design pattern instances with well-defined property guarantees and usage rules, which are suitable for automatic verification. The guaranteed properties are explicitly used to select components according to key system requirements. The D4V hypothesis is that the same general architecture and design principles leading to good modularity, extensibility and complexity/functionality ratio can be adapted to overcome some of the limitations of conventional reliability assurance measures, such as too large a state space or too many execution paths.

Author

Computer Programming; Software Engineering; Design Analysis; Programming Languages; Systems Integration

20030054509 NASA Ames Research Center, Moffett Field, CA, USA

Applying Model-Based Reasoning to the FDIR of the Command and Data Handling Subsystem of the International Space Station

Robinson, Peter; Shirley, Mark; Fletcher, Daryl; Alena, Rick; Duncavage, Dan; Lee, Charles; [2003]; 8 pp.; In English; ISAIRAS 2003, 19-23 May 2003, Nara, Japan; Copyright; Avail: CASI; [A02](#), Hardcopy

All of the International Space Station (ISS) systems which require computer control depend upon the hardware and software of the Command and Data Handling System (C&DH) system, currently a network of over 30 386-class computers called Multiplexor/Dimultiplexors (MDMs)[18]. The Caution and Warning System (C&W)[7], a set of software tasks that runs on the MDMs, is responsible for detecting, classifying, and reporting errors in all ISS subsystems including the C&DH. Fault Detection, Isolation and Recovery (FDIR) of these errors is typically handled with a combination of automatic and human effort. We are developing an Advanced Diagnostic System (ADS) to augment the C&W system with decision support tools to aid in root cause analysis as well as resolve differing human and machine C&DH state estimates. These tools which draw from sources in model-based reasoning[16,291, will improve the speed and accuracy of flight controllers by reducing the uncertainty in C&DH state estimation, allowing for a more complete assessment of risk. We have run tests with ISS telemetry and focus on those C&W events which relate to the C&DH system itself. This paper describes our initial results and subsequent plans.

Author

Decision Support Systems; Warning Systems; Computer Programs; Fault Detection; Numerical Control; Data Systems

20030054511 NASA Ames Research Center, Moffett Field, CA, USA

Technology Transfer Challenges for High-Assurance Software Engineering Tools

Koga, Dennis, Technical Monitor; Penix, John; Markosian, Lawrence Z.; April 08, 2003; 4 pp.; In English; International Conference on Software Engineering 2003 Workshop on Software Engineering for High Assurance Systems, May 3, 2003, Portland, OR, USA

Contract(s)/Grant(s): NAS2-00065; No Copyright; Avail: CASI; [A01](#), Hardcopy

In this paper, we describe our experience with the challenges that we are currently facing in our effort to develop advanced software verification and validation tools. We categorize these challenges into several areas: cost benefits modeling, tool usability, customer application domain, and organizational issues. We provide examples of challenges in each area and identify open research issues in areas which limit our ability to transfer high-assurance software engineering tools into practice.

Author

Software Development Tools; Mathematical Models; Software Engineering; Cost Analysis; Program Verification (Computers); Computer Programming; Technology Transfer

20030054536 NASA Ames Research Center, Moffett Field, CA, USA

Hosted Services for Advanced V and V Technologies: An Approach to Achieving Adoption without the Woes of Usage

Koga, Dennis, Technical Monitor; Penix, John; Markosian, Lawrence Z.; OMalley, Owen; Brew, William A.; April 08, 2003; 4 pp.; In English; International Conference on Software Engineering 2003 Workshop on Adoption-Centric Software Engineering, May 3, 2003, Portland, OR, USA

Contract(s)/Grant(s): NAS2-00065; Copyright; Avail: CASI; [A01](#), Hardcopy

Attempts to achieve widespread use of software verification tools have been notably unsuccessful. Even 'straightforward', classic, and potentially effective verification tools such as lint-like tools face limits on their acceptance. These limits are imposed by the expertise required applying the tools and interpreting the results, the high false positive rate of many verification tools, and the need to integrate the tools into development environments. The barriers are even greater for more complex advanced technologies such as model checking. Web-hosted services for advanced verification technologies may mitigate these problems by centralizing tool expertise. The possible benefits of this approach include eliminating the need for software developer expertise in tool application and results filtering, and improving integration with other development tools.

Author

Program Verification (Computers); Software Development Tools; Software Reliability; Computer Networks; Operating Systems (Computers); Systems Integration

20030054563 NASA Ames Research Center, Moffett Field, CA, USA

Propel: Tools and Methods for Practical Source Code Model Checking

Mansouri-Samani, Massoud; Mehltz, Peter; Markosian, Lawrence; OMalley, Owen; Martin, Dale; Moore, Lantz; Penix, John; Visser, Willem; April 08, 2003; 2 pp.; In English; International Conference on Dependable Systems and Networks, 22-25 Jun. 2003, San Francisco, CA, USA

Contract(s)/Grant(s): NAS2-00065; Copyright; Avail: CASI; [A01](#), Hardcopy

The work reported here is an overview and snapshot of a project to develop practical model checking tools for in-the-loop verification of NASA's mission-critical, multithreaded programs in Java and C++. Our strategy is to develop and evaluate both

a design concept that enables the application of model checking technology to C++ and Java, and a model checking toolset for C++ and Java. The design concept and the associated model checking toolset is called Propel. It builds upon the Java PathFinder (JPF) tool, an explicit state model checker for Java applications developed by the Automated Software Engineering group at NASA Ames Research Center. The design concept that we are developing is Design for Verification (D4V). This is an adaption of existing best design practices that has the desired side-effect of enhancing verifiability by improving modularity and decreasing accidental complexity. D4V, we believe, enhances the applicability of a variety of V&V approaches; we are developing the concept in the context of model checking. The model checking toolset, Propel, is based on extending JPF to handle C++. Our principal tasks in developing the toolset are to build a translator from C++ to Java, productize JPF, and evaluate the toolset in the context of D4V. Through all these tasks we are testing Propel capabilities on customer applications. Derived from text

Program Verification (Computers); Hardware-In-The-Loop Simulation; Computer Systems Programs; Applications Programs (Computers); Software Development Tools; Models

20030055153 NASA Ames Research Center, Moffett Field, CA, USA

Design for Verification: Enabling Verification of High Dependability Software-Intensive Systems

Mehlitz, Peter C.; Penix, John; Markosian, Lawrence Z.; Koga, Dennis, Technical Monitor; April 18, 2003; 3 pp.; In English; 15th International Conference on Automated Software Engineering (ASE), 1 Sep. 2000, Grenoble, France

Contract(s)/Grant(s): NAS2-00065; Copyright; Avail: CASI; [A01](#), Hardcopy

Strategies to achieve confidence that high-dependability applications are correctly implemented include testing and automated verification. Testing deals mainly with a limited number of expected execution paths. Verification usually attempts to deal with a larger number of possible execution paths. While the impact of architecture design on testing is well known, its impact on most verification methods is not as well understood. The Design for Verification approach considers verification from the application development perspective, in which system architecture is designed explicitly according to the application's key properties. The D4V-hypothesis is that the same general architecture and design principles that lead to good modularity, extensibility and complexity/functionality ratio can be adapted to overcome some of the constraints on verification tools, such as the production of hand-crafted models and the limits on dynamic and static analysis caused by state space explosion.

Author

Program Verification (Computers); Automatic Control; Software Engineering; Performance Tests; Architecture (Computers)

62

COMPUTER SYSTEMS

Includes computer networks and distributed processing systems. For information systems see *82 Documentation and Information Science*. For computer systems applied to specific applications, see the associated category.

20030053388 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Image Processor Electronics (IPE): The High-Performance Computing System for NASA SWIFT Mission

Nguyen, Quang H.; Settles, Beverly A.; April 22, 2003; 6 pp.; In English; International Conference on Communications in Computing, 23-26 Jun. 2003, Las Vegas, NV, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; [A02](#), Hardcopy

Gamma Ray Bursts (GRBs) are believed to be the most powerful explosions that have occurred in the Universe since the Big Bang and are a mystery to the scientific community. Swift, a NASA mission that includes international participation, was designed and built in preparation for a 2003 launch to help to determine the origin of Gamma Ray Bursts. Locating the position in the sky where a burst originates requires intensive computing, because the duration of a GRB can range between a few milliseconds up to approximately a minute. The instrument data system must constantly accept multiple images representing large regions of the sky that are generated by sixteen gamma ray detectors operating in parallel. It then must process the received images very quickly in order to determine the existence of possible gamma ray bursts and their locations. The high-performance instrument data computing system that accomplishes this is called the Image Processor Electronics (IPE). The IPE was designed, built and tested by NASA Goddard Space Flight Center (GSFC) in order to meet these challenging requirements. The IPE is a small size, low power and high performing computing system for space applications. This paper

addresses the system implementation and the system hardware architecture of the IPE. The paper concludes with the IPE system performance that was measured during end-to-end system testing.

Author

NASA Space Programs; Systems Engineering; Space Missions; Computer Systems Design; Spacecraft Instruments; Electronics; Image Processing

20030053420 NASA Goddard Space Flight Center, Greenbelt, MD, USA

A Distributed Simulation Software System for Multi-Spacecraft Missions

Burns, Richard; Davis, George; Cary, Everett; [2003]; 4 pp.; In English; AIAA Modeling and Simulation, August 2003, San Antonio, TX, USA; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy

The paper will provide an overview of the web-based distributed simulation software system developed for end-to-end, multi-spacecraft mission design, analysis, and test at the NASA Goddard Space Flight Center (GSFC). This software system was developed for an internal research and development (IR&D) activity at GSFC called the Distributed Space Systems (DSS) Distributed Synthesis Environment (DSE). The long-term goal of the DSS-DSE is to integrate existing GSFC stand-alone test beds, models, and simulation systems to create a 'hands on', end-to-end simulation environment for mission design, trade studies and simulations. The short-term goal of the DSE was therefore to develop the system architecture, and then to prototype the core software simulation capability based on a distributed computing approach, with demonstrations of some key capabilities by the end of Fiscal Year 2002 (FY02). To achieve the DSS-DSE IR&D objective, the team adopted a reference model and mission upon which FY02 capabilities were developed. The software was prototyped according to the reference model, and demonstrations were conducted for the reference mission to validate interfaces, concepts, etc. The reference model, illustrated in Fig. 1, included both space and ground elements, with functional capabilities such as spacecraft dynamics and control, science data collection, space-to-space and space-to-ground communications, mission operations, science operations, and data processing, archival and distribution addressed.

Author

Computer Systems Programs; Distributed Processing; Software Engineering; Space Missions; Computer Systems Simulation; Architecture (Computers)

20030054351 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Monitoring and Assimilation of MLS Measurements in the DAO Ozone Data Assimilation System

Atlas, Robert, Technical Monitor; Winslow, Nathan; Stajner, Ivanka; Rood, Richard; [2002]; 1 pp.; In English; AMS 12th Conference on Middle Atmosphere, 4-8 Nov. 2002, San Antonio, TX, USA

Report No.(s): Paper-50664; No Copyright; Avail: Other Sources; Abstract Only

Since 1999 the DAO (Data Assimilation Office) at NASA Goddard has operationally assimilated ozone measurements in near real time. Currently, the assimilation system analyzes SBUV profile and total column measurements using an off line CTM with parameterized chemistry within the 3D-PSAS algorithm. During the last year the assimilation system was modified to either monitor or actively assimilate MLS (Microwave Limb Sounder) measurements in conjunction with the active assimilation of TOMS total column and SBUV profiles. It is expected that the active assimilation of MLS profiles will improve analysis results in two ways. First, there should be an improvement in the vertical resolution. Second, there should be an improvement in regions where SBUV measurements do not exist (such as in the polar night). A series of experiments using UARS (Upper Atmospheric Research Satellite) MLS data from December 1991 to March 1992 were run. In these experiments MLS data was either monitored in conjunction with active assimilation of the SBUV profile and TOMS total column measurements, or some combination of MLS, TOMS, and SBUV observations was actively assimilated. Monitoring of MLS data indicated that the MLS observations contain verifiable information that should improve the vertical structure of the analysis results, especially below the ozone peak and above the tropopause. The monitoring also substantiated the potential to improve the assimilation in the polar night. Active assimilation of MLS data does indeed improve the analysis results in these two ways, although the quality of the improvements is not uniform. This suggests that refinement of the specification of the error covariances might be needed to optimize the system. In addition it may be necessary to account for biases between the different sources of ozone information.

Author

Data Integration; Data Systems; Ozone; Satellite Observation; Data Management; Computer Programming

20030054497 AMTI, USA

The Hyperwall

Biegel, Bryan A., Technical Monitor; Sandstrom, Timothy A.; Henze, Chris; Levit, Creon; [2003]; 8 pp.; In English; CMV 2003 Conference, July 2003, London, UK; Original contains black and white illustrations

Contract(s)/Grant(s): DTTS59-99-D-00437; NASA Order A-61812-D; No Copyright; Avail: CASI; [A02](#), Hardcopy

This paper presents the hyperwall, a visualization cluster that uses coordinated visualizations for interactive exploration of multidimensional data and simulations. The system strongly leverages the human eye-brain system with a generous 7x7 array of flat panel LCD screens powered by a Beowulf cluster. With each screen backed by a workstation class PC, graphic and compute intensive applications can be applied to a broad range of data. Navigational tools are presented that allow for investigation of high dimensional spaces.

Author

Scientific Visualization; Data Simulation; Computer Systems Design; Applications Programs (Computers); Architecture (Computers)

20030054508 Computer Sciences Corp., Moffett Field, CA, USA

Performance Analysis of Multilevel Parallel Applications on Shared Memory Architectures

Biegel, Bryan A., Technical Monitor; Jost, G.; Jin, H.; Labarta J.; Gimenez, J.; Caubet, J.; April 22, 2003; 14 pp.; In English; International Parallel and Distributed Processing Symposium, Apr. 2003, Nice, France; Original contains black and white illustrations

Contract(s)/Grant(s): DTTS59-99-D-00437; NASA Order A-61812-D; Copyright; Avail: CASI; [A03](#), Hardcopy

Parallel programming paradigms include process level parallelism, thread level parallelization, and multilevel parallelism. This viewgraph presentation describes a detailed performance analysis of these paradigms for Shared Memory Architecture (SMA). This analysis uses the Paraver Performance Analysis System. The presentation includes diagrams of a flow of useful computations.

CASI

Architecture (Computers); Performance Tests; Computer Systems Performance; Parallel Processing (Computers)

20030054548 Computer Sciences Corp., Moffett Field, CA, USA

Experiences using OpenMP based on Computer Directed Software DSM on a PC Cluster

Hess, Matthias; Jost, Gabriele; Mueller, Matthias; Ruehle, Roland; September 01, 2003; 13 pp.; In English; WOMPAT, Feb. 2003

Contract(s)/Grant(s): DTTS59-99-D-00437; NAS2-14303; NASA Order A-61812-D; Copyright; Avail: CASI; [A03](#), Hardcopy

In this work we report on our experiences running OpenMP programs on a commodity cluster of PCs running a software distributed shared memory (DSM) system. We describe our test environment and report on the performance of a subset of the NAS Parallel Benchmarks that have been automatically parallelized for OpenMP. We compare the performance of the OpenMP implementations with that of their message passing counterparts and discuss performance differences.

Author

Computer Programs; Distributed Memory; Personal Computers

63

CYBERNETICS, ARTIFICIAL INTELLIGENCE AND ROBOTICS

Includes feedback and control theory, information theory, machine learning, and expert systems. For related information see also [54](#) *Man/System Technology and Life Support*.

20030053160 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Application of Artificial Intelligence Techniques in Unmanned Aerial Vehicle Flight

Bauer, Frank H., Technical Monitor; Dufrene, Warren R., Jr.; [2003]; 1 pp.; In English; 22nd Digital Avionics System Conference, 12-16 Oct. 2003, Indianapolis, IN, USA; No Copyright; Avail: Other Sources; Abstract Only

This paper describes the development of an application of Artificial Intelligence for Unmanned Aerial Vehicle (UAV) control. The project was done as part of the requirements for a class in Artificial Intelligence (AI) at Nova southeastern University and as an adjunct to a project at NASA Goddard Space Flight Center's Wallops Flight Facility for a resilient, robust, and intelligent UAV flight control system. A method is outlined which allows a base level application for applying an AI method, Fuzzy Logic, to aspects of Control Logic for UAV flight. One element of UAV flight, automated altitude hold, has

been implemented and preliminary results displayed. A low cost approach was taken using freeware, gnu, software, and demo programs. The focus of this research has been to outline some of the AI techniques used for UAV flight control and discuss some of the tools used to apply AI techniques. The intent is to succeed with the implementation of applying AI techniques to actually control different aspects of the flight of an UAV.

Author

Pilotless Aircraft; Artificial Intelligence; Control Systems Design; Flight Control; University Program

20030054507 NASA Ames Research Center, Moffett Field, CA, USA

A Survey of Space Robotics

Pedersen, L.; Kortenkamp, D.; Wettergreen, D.; Nourbakhsh, I.; Korsmeyer, David, Technical Monitor; March 17, 2003; 8 pp.; In English; ISAIRAS, 19-24 May 2003, Nara, Japan; Original contains black and white illustrations; Copyright; Avail: CASI; [A02](#), Hardcopy

In this paper we summarize a survey conducted by NASA to determine the state-of-the-art in space robotics and to predict future robotic capabilities under either nominal and intensive development effort. The space robotics assessment study examined both in-space operations including assembly, inspection, and maintenance and planetary surface operations like mobility and exploration. Applications of robotic autonomy and human-robot cooperation were considered. The study group devised a decomposition of robotic capabilities and then suggested metrics to specify the technical challenges associated with each. The conclusion of this paper identifies possible areas in which investment in space robotics could lead to significant advances of important technologies.

Author

Robotics; Multisensor Fusion; Systems Engineering; Roving Vehicles; Robots; Robot Control; Assembling; Adaptive Control; Control Systems Design; Planetary Surfaces

20030054521 NASA Ames Research Center, Moffett Field, CA, USA

Direct Manipulation in Virtual Reality

Bryson, Steve; [2003]; 30 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): 704-40-42; No Copyright; Avail: CASI; [A03](#), Hardcopy

Virtual Reality interfaces offer several advantages for scientific visualization such as the ability to perceive three-dimensional data structures in a natural way. The focus of this chapter is direct manipulation, the ability for a user in virtual reality to control objects in the virtual environment in a direct and natural way, much as objects are manipulated in the real world. Direct manipulation provides many advantages for the exploration of complex, multi-dimensional data sets, by allowing the investigator the ability to intuitively explore the data environment. Because direct manipulation is essentially a control interface, it is better suited for the exploration and analysis of a data set than for the publishing or communication of features found in that data set. Thus direct manipulation is most relevant to the analysis of complex data that fills a volume of three-dimensional space, such as a fluid flow data set. Direct manipulation allows the intuitive exploration of that data, which facilitates the discovery of data features that would be difficult to find using more conventional visualization methods. Using a direct manipulation interface in virtual reality, an investigator can, for example, move a data probe about in space, watching the results and getting a sense of how the data varies within its spatial volume.

Derived from text

Scientific Visualization; Computer Graphics; Virtual Reality; Data Structures; Data Processing; Computerized Simulation; Three Dimensional Models; Computer Programming

64

NUMERICAL ANALYSIS

Includes iteration, differential and difference equations, and numerical approximation.

20030054476 Texas A&M Univ., TX, USA

Hierarchical Strategy for Rapid Analysis Environment

Whitcomb, John; May 2003; 54 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAG1-01080; No Copyright; Avail: CASI; [A04](#), Hardcopy

A new philosophy is developed wherein the hierarchical definition of data is made use of in creating a better environment to conduct analyses of practical problems. This system can be adapted to conduct virtually any type of analysis, since this philosophy is not bound to any specific kind of analysis. It provides a framework to manage different models and its results

and more importantly, the interaction between the different models. Thus, it is ideal for many types of finite element analyses like global/local analysis and those that involve multiple scales and fields. The system developed during the course of this work is just a demonstrator of the basic concepts. A complete implementation of this strategy could potentially make a major impact on the way analyses are conducted. It could considerably reduce the time frame required to conduct the analysis of real-life problems by efficient management of the data involved and reducing the human effort involved. It also helps in better decision making because of more ways to interpret the results. The strategy has been currently implemented for structural analysis, but with more work it could be extended to other fields of science when the finite element method is used to solve the differential equations numerically. This report details the work that has been done during the course of this project and its achievements and results. The following section discusses the meaning of the word hierarchical and the different references to the term in the literature. It talks about the development of the finite element method, its different versions and how hierarchy has been used to improve the methodology. The next section describes the hierarchical philosophy in detail and explains the different concepts and terms associated with it. It goes on to describe the implementation and the features of the demonstrator. A couple of problems are analyzed using the demonstrator program to show the working of the system. The two problems considered are two dimensional plane stress analysis problems. The results are compared with those obtained using conventional analysis. The different challenges faced during the development of this system are discussed. Finally, we conclude with suggestions for future work to add more features and extend it to a wider range of problems.

Author

Decision Making; Finite Element Method; Hierarchies; Prediction Analysis Techniques

20030054520 Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, USA

Interface Finite Elements for the Analysis of Fracture Initiation and Progression

Ambur, Damodar R., Technical Monitor; Johnson, Eric R.; June 02, 2003; 6 pp.; In English

Contract(s)/Grant(s): NCC1-398; No Copyright; Avail: CASI; [A02](#), Hardcopy

Progressive failure analyses (PFA) are important for the prediction of residual strength and damage tolerance of vehicle structures, and to predict the energy absorbing capability of vehicle structures under crash-type loads. Typically continuum damage mechanics (CDM) and fracture mechanics (FM) are the methods used for PFA. The method of interfacial damage mechanics (IDM) is used for PFA in this research. IDM has capabilities intermediate between CDM and FM, and is used to numerically model the initiation, growth, and arrest of cracks. IDM smooths the stress singularity at the crack tip, and is easily adaptable with other nonlinearities such as plasticity and material damage. IDM is implemented by user-defined interface elements in the ABAQUS/ Standard structural analysis software package. The structural components selected to demonstrate the effectiveness PFA using interface elements are, for the most part, those with published test data. These structural components were subjected to quasi-static loading in the tests. Thus, the ABAQUS analyses are used to predict geometrically and materially nonlinear equilibrium states. Impact loading, dynamic fracture, reflected stress waves, inertia, and time dependent material behavior are not considered.

Author

Failure Analysis; Impact Tolerances; Spacecraft Structures; Reliability Analysis; Performance Prediction; Applications Programs (Computers); Direct Numerical Simulation; Structural Analysis; Crack Initiation

20030055155 NASA Goddard Space Flight Center, Greenbelt, MD, USA

On the use of the Log-Normal Particle Size Distribution to Characterize Global Rain

Meneghini, Robert; Rincon, Rafael; Liao, Liang; [2003]; 1 pp.; In English; 2003 IEEE International Geoscience and Remote Sensing Symposium, 21-25 Jul. 2003, Toulouse, France; No Copyright; Avail: Other Sources; Abstract Only

Although most parameterizations of the drop size distributions (DSD) use the gamma function, there are several advantages to the log-normal form, particularly if we want to characterize the large scale space-time variability of the DSD and rain rate. The advantages of the distribution are twofold: the logarithm of any moment can be expressed as a linear combination of the individual parameters of the distribution; the parameters of the distribution are approximately normally distributed. Since all radar and rainfall-related parameters can be written approximately as a moment of the DSD, the first property allows us to express the logarithm of any radar/rainfall variable as a linear combination of the individual DSD parameters. Another consequence is that any power law relationship between rain rate, reflectivity factor, specific attenuation or water content can be expressed in terms of the covariance matrix of the DSD parameters. The joint-normal property of the DSD parameters has applications to the description of the space-time variation of rainfall in the sense that any radar-rainfall quantity can be specified by the covariance matrix associated with the DSD parameters at two arbitrary space-time points. As such, the parameterization provides a means by which we can use the spaceborne radar-derived DSD parameters to specify in part the covariance matrices globally. However, since satellite observations have coarse temporal sampling, the specification

of the temporal covariance must be derived from ancillary measurements and models. Work is presently underway to determine whether the use of instantaneous rain rate data from the TRMM Precipitation Radar can provide good estimates of the spatial correlation in rain rate from data collected in $5(\sup 0) \times 5(\sup 0) \times 1$ month space-time boxes. To characterize the temporal characteristics of the DSD parameters, disdrometer data are being used from the Wallops Flight Facility site where as many as 4 disdrometers have been used to acquire data over a 2 km path. These data should help quantify the temporal form of the covariance matrix at this site.

Author

Logarithms; Particle Size Distribution; Drop Size; Rain; Parameterization; Mathematical Models; Matrices (Mathematics)

65

STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; time series analysis; and stochastic processes.

20030053149 Vanderbilt Univ., Nashville, TN, USA

System Risk Assessment and Allocation in Conceptual Design

Mahadevan, Sankaran; Smith, Natasha L.; Zang, Thomas A., Technical Monitor; May 2003; 105 pp.; In English

Contract(s)/Grant(s): NCC1-01031; RTOP 706-31-61-01

Report No.(s): NASA/CR-2003-212162; NAS 1.26:21262; No Copyright; Avail: CASI; [A06](#), Hardcopy

As aerospace systems continue to evolve in addressing newer challenges in air and space transportation, there exists a heightened priority for significant improvement in system performance, cost effectiveness, reliability, and safety. Tools, which synthesize multidisciplinary integration, probabilistic analysis, and optimization, are needed to facilitate design decisions allowing trade-offs between cost and reliability. This study investigates tools for probabilistic analysis and probabilistic optimization in the multidisciplinary design of aerospace systems. A probabilistic optimization methodology is demonstrated for the low-fidelity design of a reusable launch vehicle at two levels, a global geometry design and a local tank design. Probabilistic analysis is performed on a high fidelity analysis of a Navy missile system. Furthermore, decoupling strategies are introduced to reduce the computational effort required for multidisciplinary systems with feedback coupling.

Author

Multidisciplinary Design Optimization; Aerospace Systems; Probability Theory; Reliability Analysis; Design Analysis; Risk; Systems Engineering; Models

20030054479 NASA Ames Research Center, Moffett Field, CA, USA

Scheduling in the Face of Uncertain Resource Consumption and Utility

Koga, Dennis, Technical Monitor; Frank, Jeremy; Dearden, Richard; [2003]; 15 pp.; In English; 2003 ICAPS Workshop on Plan Execution, 2003; No Copyright; Avail: CASI; [A03](#), Hardcopy

We discuss the problem of scheduling tasks that consume a resource with known capacity and where the tasks have varying utility. We consider problems in which the resource consumption and utility of each activity is described by probability distributions. In these circumstances, we would like to find schedules that exceed a lower bound on the expected utility when executed. We first show that while some of these problems are NP-complete, others are only NP-Hard. We then describe various heuristic search algorithms to solve these problems and their drawbacks. Finally, we present empirical results that characterize the behavior of these heuristics over a variety of problem classes.

Author

Scheduling; Heuristic Methods; Resource Allocation; Probability Theory; Algorithms; Mathematical Models; Functions (Mathematics)

20030055158 NASA Marshall Space Flight Center, Huntsville, AL, USA

Using Clustering to Establish Climate Regimes from PCM Output

Oglesby, Robert; Arnold, James E., Technical Monitor; Hoffman, Forrest; Hargrove, W. W.; Erickson, D.; [2002]; 1 pp.; In English; American Geophysical Union Fall Meeting, 5-11 Dec. 2002, San Francisco, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

A multivariate statistical clustering technique--based on the k-means algorithm of Hartigan has been used to extract patterns of climatological significance from 200 years of general circulation model (GCM) output. Originally developed and implemented on a Beowulf-style parallel computer constructed by Hoffman and Hargrove from surplus commodity desktop PCs, the high performance parallel clustering algorithm was previously applied to the derivation of ecoregions from map

stacks of 9 and 25 geophysical conditions or variables for the conterminous U.S. at a resolution of 1 sq km. Now applied both across space and through time, the clustering technique yields temporally-varying climate regimes predicted by transient runs of the Parallel Climate Model (PCM). Using a business-as-usual (BAU) scenario and clustering four fields of significance to the global water cycle (surface temperature, precipitation, soil moisture, and snow depth) from 1871 through 2098, the authors' analysis shows an increase in spatial area occupied by the cluster or climate regime which typifies desert regions (i.e., an increase in desertification) and a decrease in the spatial area occupied by the climate regime typifying winter-time high latitude perma-frost regions. The patterns of cluster changes have been analyzed to understand the predicted variability in the water cycle on global and continental scales. In addition, representative climate regimes were determined by taking three 10-year averages of the fields 100 years apart for northern hemisphere winter (December, January, and February) and summer (June, July, and August). The result is global maps of typical seasonal climate regimes for 100 years in the past, for the present, and for 100 years into the future. Using three-dimensional data or phase space representations of these climate regimes (i.e., the cluster centroids), the authors demonstrate the portion of this phase space occupied by the land surface at all points in space and time. Any single spot on the globe will exist in one of these climate regimes at any single point in time. By incrementing time, that same spot will trace out a trajectory or orbit between and among these climate regimes (or atmospheric states) in phase (or state) space. When a geographic region enters a state it never previously visited, a climatic change is said to have occurred. Tracing out the entire trajectory of a single spot on the globe yields a 'manifold' in state space representing the shape of its predicted climate occupancy. This sort of analysis enables a researcher to more easily grasp the multivariate behavior of the climate system.

Author

Cluster Analysis; Climate Models; Temporal Distribution; Multivariate Statistical Analysis; Parallel Processing (Computers); Climate Change; Performance Prediction

66

SYSTEMS ANALYSIS AND OPERATIONS RESEARCH

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

20030054480 NASA Ames Research Center, Moffett Field, CA, USA

Constraint Reasoning Over Strings

Koga, Dennis, Technical Monitor; Golden, Keith; Pang, Wanlin; April 15, 2003; 15 pp.; In English; Constraint Programming 2003, 9 Sep. 2003, Kinsale, Ireland; No Copyright; Avail: CASI; [A03](#), Hardcopy

This paper discusses an approach to representing and reasoning about constraints over strings. We discuss how many string domains can often be concisely represented using regular languages, and how constraints over strings, and domain operations on sets of strings, can be carried out using this representation.

Author

Domains; Programming Languages; String Theory

67

THEORETICAL MATHEMATICS

Includes algebra, functional analysis, geometry, topology, set theory, group theory and number theory.

20030053173 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Generalization of the Euler Angles

Bauer, Frank H., Technical Monitor; Shuster, Malcolm D.; Markley, F. Landis; December 2002; 10 pp.; In English; Copyright; Avail: CASI; [A02](#), Hardcopy

It is shown that the Euler angles can be generalized to axes other than members of an orthonormal triad. As first shown by Davenport, the three generalized Euler axes, hereafter: Davenport axes, must still satisfy the constraint that the first two and the last two axes be mutually perpendicular if these axes are to define a universal set of attitude parameters. Expressions are given which relate the generalized Euler angles, hereafter: Davenport angles, to the 3-1-3 Euler angles of an associated direction-cosine matrix. The computation of the Davenport angles from the attitude matrix and their kinematic equation are

presented. The present work offers a more direct development of the Davenport angles than Davenport's original publication and offers additional results.

Author

Angles (Geometry); Axes (Reference Lines); Attitude (Inclination); Kinematic Equations; Matrices (Mathematics)

72

ATOMIC AND MOLECULAR PHYSICS

Includes atomic and molecular structure, electron properties, and atomic and molecular spectra. For elementary particle physics see 73
Nuclear Physics.

20030053181 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Threshold Laws for Two-Electron Ejection Processes: A Still Controversial Problem in Atomic Physics

Temkin, Aaron; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

This talk deals with collision processes of the following kind: (a) an ionizing collision of an electron with a neutral atom, (b) a photon incident of a negative ion resulting in two-electron ejection. In both cases the final state is a positive ion and two outgoing electrons, and in principle both processes should be governed by the same form of threshold law. It is generally conceded that this is one of the most difficult basic problems in nonrelativistic quantum mechanics. The standard treatment (due to Wannier) will be briefly reviewed in terms of the derivation of his well-known threshold law for the yield (Q) of positive ions vs. the excess energy (E): $Q(\text{sub } w)$ varies as $E(\exp 1.127\dots)$. The derivation is a brilliant analysis based on Newton's equations, leading to the dominance of events in which the two electrons emerge on opposite sides of the residual ion with similar energies. In contrast, I will argue on the basis of quantum mechanical ideas that in the threshold limit the more likely outcome are events in which the electrons emerge with decidedly different energies, leading to a formally different (Coulomb-dipole) threshold law $Q(\text{sub } CD)$ varies as $E(1 + C \sin(\alpha \ln(E) + \mu))/[\ln(E)](\exp 2)$. Additional aspects of that approach will be discussed. Some: experimental results will be presented, and more incisive predictions involving polarized projectiles and targets will be given.

Author

Thresholds; Electrons; Ejection; Collisions; Ionization

20030053184 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Electron-H Elastic Scattering

Bhatia, A. K.; [2003]; 1 pp.; In English; DAMOP 2003, May 2003; No Copyright; Avail: Other Sources; Abstract Only

Precision calculations for $e^{-}\text{-H}$ and $e^{-}\text{-He}^{+}$ for S-wave scattering in the elastic region have been carried out using the optical potential approach. This formalism is now extended to $e^{-}\text{-H}$ P-wave scattering in the elastic region. The scattering equations are solved by the non-iterative method. Phase shifts are calculated using Hylleraas-type correlation functions up to 84 terms. Results are rigorous lower bounds to the exact phase shifts and they are compared to those obtained in previous calculations.

Author

Electron Scattering; Elastic Scattering; Atomic Collisions; Mathematical Models

20030053187 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Calculation of the Full Scattering Amplitude without Partial Wave Decomposition II: Inclusion of Exchange

Shertzer, Janine; Temkin, A.; [2003]; 1 pp.; In English; DAMOP 2003, 21-24 May 2003, Boulder, CO, USA; Copyright; Avail: Other Sources; Abstract Only

As is well known, the full scattering amplitude can be expressed as an integral involving the complete scattering wave function. We have shown that the integral can be simplified and used in a practical way. Initial application to electron-hydrogen scattering without exchange was highly successful. The Schrodinger equation (SE), which can be reduced to a 2d partial differential equation (pde), was solved using the finite element method. We have now included exchange by solving the resultant SE, in the static exchange approximation, which is reducible to a pair of coupled pde's. The resultant scattering amplitudes, both singlet and triplet, calculated as a function of energy are in excellent agreement with converged partial wave results.

Author

Scattering Amplitude; Scattering Functions; Wave Functions; Integrals; Electron Scattering; Decomposition

20030053449 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Re-examination of a Simplified Model for Positronium-Helium Scattering

DiRienzi, Joseph; Drachman, Richard J.; [2003]; 1 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

Using a local effective potential to account for electron exchange, R J Drachman and S K Houston analyzed the zero-energy scattering of ortho-positronium by helium atoms in 1970. The idea was to use the existing static-exchange results to fit the parameters of the local potential and then to use the potential in a variational target-elastic calculation. The results were remarkably good, both for the scattering length and the annihilation parameter. Recently, however, a rigorous target-elastic calculation by Blackwood et al disagreed so strongly with these old results that we have undertaken a re-examination. We find that one of the apparently trivial assumptions of the local potential method is much more important than previously believed.

Author

Helium Atoms; Positronium; Models; Electrons

73

NUCLEAR PHYSICS

Includes nuclear particles; and reactor theory. For space radiation see *93 Space Radiation*. For atomic and molecular physics see *72 Atomic and Molecular Physics*. For elementary particle physics see *77 Physics of Elementary Particles and Fields*. For nuclear astrophysics see *90 Astrophysics*.

20030053392 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Decay Properties of K-Vacancy States in Fe X-Fe XVII

Mendoza, C.; Kallman, T. R.; Bautista, M. A.; Palmeri, P.; May 2003; 12 pp.; In English; Copyright; Avail: CASI; [A03](#), Hardcopy

We report extensive calculations of the decay properties of fine-structure K-vacancy levels in Fe X-Fe XVII. A large set of level energies, wavelengths, radiative and Auger rates, and fluorescence yields has been computed using three different standard atomic codes, namely Cowan's HFR, AUTOSTRUCTURE and the Breit-Pauli R-matrix package. This multi-code approach is used to study the effects of core relaxation, configuration interaction and the Breit interaction, and enables the estimate of statistical accuracy ratings. The Ksigma and KLL Auger widths have been found to be nearly independent of both the outer-electron configuration and electron occupancy keeping a constant ratio of 1.53 +/- 0.06. By comparing with previous theoretical and measured wavelengths, the accuracy of the present set is determined to be within 2 m Angstrom. Also, the good agreement found between the different radiative and Auger data sets that have been computed allow us to propose with confidence an accuracy rating of 20% for the line fluorescence yields greater than 0.01. Emission and absorption spectral features are predicted finding good correlation with measurements in both laboratory and astrophysical plasmas.

Author

Atomic Spectra; X Rays; K Lines; Iron; X Ray Spectroscopy; Computerized Simulation; Computational Astrophysics

20030053435 Institute for Scientific Research, Fairmont, WV, USA

Fissioning Plasma Core Reactor

Albright, Dennis; Butler, Carey; West, Nicole; Cole, John W., Technical Monitor; [2002]; 19 pp.; In English; 14th Annual Symposium on Propulsion, 10-11 Dec. 2002, University Park, PA, USA; Original contains color illustrations
Contract(s)/Grant(s): NCC8-225; No Copyright; Avail: CASI; [A03](#), Hardcopy

Institute for Scientific Research, Inc. (ISR) research program consist of: 1. Study core physics by adapting existing codes: MCNP4C - Monte Carlo code; COMBINE/VENTURE - diffusion theory; SCALE4 - Monte Carlo, with many utility codes. 2. Determine feasibility and study major design parameters: fuel selection, temperature and reflector sizing. 3. Study reactor kinetics: develop QCALC1 to model point kinetics; study dynamic behavior of the power release.

Derived from text

Plasma Core Reactors; Diffusion Theory; Dynamic Characteristics

74 OPTICS

Includes light phenomena and the theory of optical devices; for specific optical devices see also *35 Instrumentation and Photography*. For lasers see *36 Lasers and Masers*.

20030053383 NASA Goddard Space Flight Center, Greenbelt, MD, USA

LISA Optics Model: Computational Steps

Waluschka, Eugene; [2003]; 1 pp.; In English; SPIE Conference, 3-8 Aug. 2003, San Diego, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

The Laser Interferometer Space Antenna (LISA) optics model is used to propagate a laser beam inside and between widely, five million kilometers, separated spacecraft moving in orbits about the sun. Numerical beam propagation models have been around for a long time. However, because of the somewhat extreme requirements on the model, namely very large distances while still requiring sub-picometer accuracies, a detailed exposition of the computational steps is necessary to ensure that the results are understood.

Author

Lisa (Observatory); Optics; Mathematical Models; Laser Beams

20030054347 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Technologies and Mission Concepts for NHST

Oegerle, William R.; [2003]; 1 pp.; In English; American Astronomical Society Meeting, 28 May 2003; No Copyright; Avail: Other Sources; Abstract Only

A technology workshop entitled 'Innovative Designs for the Next Large Aperture Optical/UV Telescope' was held on April 10-11 at the Space Telescope Science Institute in Baltimore. This workshop was held to consider the technologies that will be required to support optical/UV space missions designed to carry out the science envisioned by the Hubble Science Legacy meeting held in April 2002 in Chicago. Subjects covered at the workshop included: optical designs, wavefront control, mirror technologies, spectrographs, coronagraphs, detector technologies, and in-space construction. A summary of the workshop and near-term plans for investigating several mission concepts will be provided. Funding for this workshop was provided by NASA.

Author

Ultraviolet Astronomy; Apertures; Spaceborne Telescopes; Mission Planning

20030054360 NASA Goddard Space Flight Center, Greenbelt, MD, USA

An All-Optical Picosecond Switch in Polydiacetylene

Abdeldayem, Hossin; Frazier, Donald O.; Paley, Mark S.; August 13, 2002; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Polydiacetylene derivative of 2-methyl-4-nitroaniline (PDAMNA) showed a picosecond switching property. This phenomenon was demonstrated by wave guiding a cw He-Ne laser collinearly with a mode-locked picosecond Nd:YAG laser at 532 nm through a hollow fiber coated on the inside with a thin film of PDAMNA. The z-scan investigations of PDAMNA thin film revealed that the PDAMNA system is a three level system and the switching is caused by excited state absorption of the He-Ne beam.

Author

Switches; Optoelectronic Devices; Optical Switching; Acetals; Methyl Compounds; Nitro Compounds; Aniline; Picosecond Pulses

76 SOLID-STATE PHYSICS

Includes condensed matter physics, crystallography, and superconductivity. For related information see also *33 Electronics and Electrical Engineering*; and *36 Lasers and Masers*.

20030053194 Clarkson Univ., Potsdam, NY, USA

Can Propagation of Gas Bubbles Lead to Detached Solidification? Experiments on Freezing of Water

Wang, Yazhen; Regel, Liya; Wilcox, William R., Americ; Crystal Growth and Design; 2002; Volume 2, No. 5, pp. 453-461; In English

Contract(s)/Grant(s): NAG8-1482

Report No.(s): CG0255063; Copyright; Avail: Other Sources

A vertical Bridgman-Stockbarger apparatus was used to directionally solidify water upward, in the hope that detached solidification would evolve from gas bubbles forming on the wall. A large contact angle of the water on the ampoule wall and a high solubility of the dissolved gas caused gas bubbles or tubes to form only at the ampoule wall, and not in the interior. Gas tubes were often nearly periodically spaced around the ampoule wall, with a spacing that increased with ampoule diameter and decreased with freezing rate. The width of the gas tubes was nearly independent of the ampoule diameter and freezing rate. A high degree of detachment was obtained with a rough, nonwetting coating on the ampoule wall, but full detachment was not achieved. This indicates that detachment does not occur by propagation of a single gas bubble around the periphery of the freezing interface. The convection near the freezing interface influenced gas bubble formation, and was outward for a concave freezing interface and inward for a convex interface.

Author

Bridgman Method; Dissolved Gases; Freezing; Water; Directional Solidification (Crystals); Bubbles; Propagation

20030053195 Clarkson Univ., Potsdam, NY, USA

Detached Solidification of InSb on Earth

Wang, Jianbin; Regel, Liya L.; Wilcox, William R.; [2003]; 19 pp.; In English

Contract(s)/Grant(s): NAG8-1482; No Copyright; Avail: CASI; [A03](#), Hardcopy

Detached solidification of lightly gallium-doped indium antimonide was achieved in the laboratory only when the ampoule was coated with hexagonal boron nitride and when the material appeared to be oxide-free. A furnace was constructed with the temperature increasing with height in order to minimize buoyancy-driven convection, so as to maximize transport of segregated dissolved gases into the gap between the growing solid and the ampoule wall. There appeared to be no difference in results with freezing rates of 5 mm/h and 10 mm/h. Best results were obtained when the ampoule was backfilled with 20 kPa of Ar-10%H₂ prior to sealing. The detached portions were depressed by several μ m from adjacent attached regions, were rough, and sometimes had microfacets and steps.

Author

Indium Antimonides; Solidification; Earth (Planet); Semiconductors (Materials)

20030053196 Clarkson Univ., Potsdam, NY, USA

Approximate Material-Balance Solution to the Moving Meniscus Model of Detached Solidification

Wang, Yazhen; Regel, Liya L.; Wilcox, William R.; Elsevi; Journal of Crystal Growth; 2002; ISSN 0022-0248; Volume 243, pp. 546-560; In English

Contract(s)/Grant(s): NAG8-1482; Copyright; Avail: Other Sources

Non-dimensionalization of the governing equations for the Moving Meniscus Model of detached solidification in zero gravity allowed consolidation of the operating conditions and physical properties into 5 dimensionless parameters: a dimensionless meniscus factor, a freezing rate Peclet number, the interfacial segregation coefficient k for dissolved gas, the ratio of gas solubility at the end of the melt to that at the meniscus, and the ratio of gas concentration in the gap to that in the adjacent melt. At steady state, the flux of gas dissolved in the melt moving toward the freezing interface must equal the sum of the flux of gas into the gap plus that being incorporated in the growing solid. Both numerical and material-balance results give two solutions, with an extremum value of each variable beyond which steady detachment is impossible. This behavior is now understood to originate from satisfaction of the material balance at two different gap widths, with these two solutions becoming identical at an extremum condition beyond which the material balance cannot be satisfied. Only one solution is obtained when no gas is incorporated in the solid. In the presence of gravity, the gas pressure in the gap must be much larger to compensate for the added hydrostatic pressure, causing the gap width to be narrow.

Author

Material Balance; Menisci; Solidification; Microgravity; Peclet Number; Solubility; Melts (Crystal Growth); Gas Pressure

20030053199 Clarkson Univ., Potsdam, NY, USA

Improved Crystal Quality by Detached Solidification in Microgravity

Regel, Liya L.; Wilcox, William R.; [2003]; 4 pp.; In English

Contract(s)/Grant(s): NAG8-1482; No Copyright; Avail: CASI; [A01](#), Hardcopy

The goals of our work on detached solidification have been to: Develop a complete understanding of all of the phenomena of detached solidification; Make it possible to achieve detached solidification reproducibly; Increase crystallographic perfection through detached solidification. Specifically, we aimed in this project to: Identify a system and develop methods that would allow viewing of the melt surface and convection in the melt during detached solidification in microgravity;

Improve understanding of the origination and evolution of detachment through experiments and theoretical treatments; Achieve detachment on earth. The project resulted in 14 publications, 15 presentations, completion of 2 Ph.D. theses, and completion of 2 M.S. theses. Two additional papers are currently being reviewed for publication. Copies of most of the papers are attached as appendices. Among the accomplishments are: Achievement of detached solidification of InSb on earth and determination of the conditions favoring detachment on earth. Development of a new method for coating the interior of silica growth ampoules with transparent boron nitride, which yields the high contact angles for semiconductor melts that favor detachment. Development of a new coating for the interior of Pyrex ampoules yielding very high contact angles for water and molten organic compounds. Development of a material-balance model for steady detached solidification that provides greatly improved insight into the process, both in microgravity and on earth. Dimensionless parameters were found that clarify the role of operating conditions and physical properties. The reason for the occurrence of two steady states was clarified, along with their relative stability. Observation of periodic gas tubes during directional solidification of water and organic compounds. Gas bubbles did not propagate around the periphery to yield full detachment. Failure to obtain detachment is attributed to the ready plastic deformation of these materials, so that the frozen material continues to adhere to the ampoule wall during cooling.

Author

Crystals; Solidification; Microgravity; Melts (Crystal Growth); Cooling; Indium Antimonides; Silicon Dioxide; Boron Nitrides; Borosilicate Glass

20030053203 Clarkson Univ., Potsdam, NY, USA

Steady State Detached Solidification of Water at Zero Gravity

Wang, Yazhen; Regel, Liya L.; Wilcox, William R., Elsevi; Journal of Crystal Growth; April 21, 2003; ISSN 0022-0248; Volume 226, pp. 430-435; In English

Contract(s)/Grant(s): NAG8-1482; Copyright; Avail: Other Sources

Steady-state detached solidification of water was calculated using the Moving Meniscus Model. Similar to the experimental observation of many materials in microgravity, detached solidification of water is predicted to occur in a sealed ampoule at zero gravity under proper conditions. For steady detachment, the freezing rate must exceed a critical value, Henry's constant of the dissolved gas must be below a critical value, the temperature of the top of the water must be below a critical value, the contact angle of water on the ampoule wall must exceed a critical value, and the diffusion coefficient must exceed a critical value. Each critical value depends on the physical properties and the other operating conditions. Thus different results are obtained for InSb and water. The critical gas pressure above the melt for water is much smaller than for InSb, the critical freezing rate is larger for water, and the critical contact angle of the melt on the ampoule wall is larger for water. For the gases examined here, the solubilities of Ar, N₂ and Ne in water are sufficient for detachment to occur, while the solubility of He is not.

Author

Steady State; Solidification; Water; Microgravity; Menisci

20030053391 Clarkson Univ., Potsdam, NY, USA

Influence of Contact Angle, Growth Angle and Melt Surface Tension on Detached Solidification of InSb

Wang, Yazhen; Regel, Liya L.; Wilcox, William R., Elsevi; Journal of Crystal Growth; 2000; ISSN 0022-0248; Volume 209, pp. 175-180; In English

Contract(s)/Grant(s): NAG8-1482; Copyright; Avail: Other Sources

We extended the previous analysis of detached solidification of InSb based on the moving meniscus model. We found that for steady detached solidification to occur in a sealed ampoule in zero gravity, it is necessary for the growth angle to exceed a critical value, the contact angle for the melt on the ampoule wall to exceed a critical value, and the melt-gas surface tension to be below a critical value. These critical values would depend on the material properties and the growth parameters. For the conditions examined here, the sum of the growth angle and the contact angle must exceed approximately 130 deg, which is significantly less than required if both ends of the ampoule are open.

Author

Indium Antimonides; Solidification; Microgravity; Drying; Interfacial Tension; Melts (Crystal Growth); Mathematical Models; Mechanical Properties

20030055152 NASA Marshall Space Flight Center, Huntsville, AL, USA

The Connection Between Local Icosahedral Order in Metallic Liquids and the Nucleation of Ordered Phases

Curreri, Peter A., Technical Monitor; Kelton, K. F.; Gangopadhyay, A.; Lee, G. W.; Hyers, R. W.; Rathz, R. J.; Rogers, J.; Schenk, T.; Simonet, V.; Holland-Moritz, D., et al.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Over fifty years ago, David Turnbull showed that the temperature of many metallic liquids could be decreased far below their equilibrium melting temperature before crystallization occurred. To explain those surprising results, Charles Frank hypothesized that the local structures of undercooled metallic liquids are different from those of crystal phases, containing a significant degree of icosahedral order that is incompatible with extended periodicity. Such structural differences must create a barrier to the formation crystal phases, explaining the observed undercooling behavior. If true, the nucleation from the liquid of phases with extended icosahedral order should be easier. Icosahedral order is often favored in small clusters, as observed recently in liquid-like clusters of pure Pb on the (111) surface of Si, for example. However, it has never been shown that an increasing preference for icosahedral phase formation can be directly linked with the development of icosahedral order in the undercooled liquid. Owing to the combination of very recent advances in levitation techniques and the availability of synchrotron x-ray and high flux neutron facilities, this is shown here.

Author

Liquid Metals; Crystallization; Microstructure; Crystal Growth; Phase Transformations; Nucleation

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SOCIAL AND INFORMATION SCIENCES (GENERAL)

Includes general research topics related to sociology; educational programs and curricula. For specific topics in these areas see categories 81 through 85.

20030053385 NASA Goddard Space Flight Center, Greenbelt, MD, USA

NASA Overview (K-12, Educators, and General Public)

Ericsson, Aprille Joy; [2003]; 16 pp.; In English; American Associate of University Women National Conference, 25 Apr. 2003, Irvine, CA, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

This viewgraph presentation provides an overview of NASA activities intended for recruitment of employees. It includes NASA's vision statement and mission, images of solar system bodies and the Sojourner rover, as well as information the Aqua satellite and the Stratospheric Aerosol and Gas Experiment III (Sage III). Images of experimental aircraft, a space shuttle, and the Hubble Space Telescope (HST) are shown, and a section on mission planning is included.

CASI

NASA Programs; Mission Planning; Personnel

84

LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes aviation law; space law and policy; international law; international cooperation; and patent policy.

20030053346 NASA Marshall Space Flight Center, Huntsville, AL, USA

Hypergolic Ignitor Assembly

Taylor, Eric S., Inventor; Myers, W. Neill, Inventor; Martin, Michael A., Inventor; December 24, 2002; 6 pp.; In English; Original contains black and white illustrations

Patent Info.: Filed 6 Jun. 2001; US-Patent-6,497,091; US-Patent-Appl-SN-877800; NASA-Case-MFS-31584-1; No Copyright; Avail: CASI; [A02](#), Hardcopy

An ignitor for use with the MC-I rocket engine has a cartridge bounded by two end caps with rupture disc assemblies connected thereto. A piston assembly within the cartridge moves from one end of the cartridge during the ignition process. The inlet of the ignitor communicates with a supply taken from the discharge of the fuel pump. When the pump is initially started, the pressure differential bursts the first rupture disc to begin the movement of the piston assembly toward the discharge end. The pressurization of the cartridge causes the second rupture to rupture and hypergolic fluid contained within the cartridge is discharged out the outlet. Once the piston assembly reaches the discharge end of the cartridge, purge grooves allow for fuel

and remaining hypergolic fluid, to be discharged out the ignitor outlet into the combustion chamber to purge the ignitor of any remaining hypergolic fluid.

Official Gazette of the U.S. Patent and Trademark Office

Ignition; Rocket Engines; Assembling; Hypergolic Rocket Propellants

20030053347 NASA Glenn Research Center, Cleveland, OH, USA

Planar Particle Imaging and Doppler Velocimetry System and Method

Wernet, Mark P., Inventor; April 1, 2003; 13 pp.; In English; Original contains black and white illustrations

Patent Info.: Filed 4 Jun. 2001; US-Patent-6,542,226; US-Patent-Appl-SN-874956; NASA-Case-LEW-17111-1; No Copyright; Avail: CASI; [A03](#), Hardcopy

A planar velocity measurement system (100) is operative to measure all three velocity components of a flowing fluid (106) across an illuminated plane (108) using only a single line of sight. The fluid flow is seeded with small particles which accurately follow the flow field fluctuations. The seeded flow field is illuminated with pulsed laser light source (102) and the positions of the particles in the flow are recorded on CCD cameras (122,124). The in-plane velocities are measured by determining the in-plane particle displacements. The out-of-plane velocity component is determined by measuring the Doppler shift of the light scattered by the particles. Both gas and liquid velocities can be measured, as well as two-phase flows.

Official Gazette of the U.S. Patent and Trademark Office

Fluid Flow; Velocity Measurement; Planar Structures; Illuminating; Methodology

20030053360 NASA Langley Research Center, Hampton, VA, USA

Passive Fetal Heart Monitoring System

Zuckerwar, Allan J., Inventor; Mowrey, Dennis L., Inventor; April 22, 2003; 13 pp.; In English

Patent Info.: Filed 13 Feb. 2001; No Copyright; Avail: CASI; [A03](#), Hardcopy

A fetal heart monitoring system and method for detecting and processing acoustic fetal heart signals transmitted by different signal transmission modes. One signal transmission mode, the direct contact mode, occurs in a first frequency band when the fetus is in direct contact with the maternal abdominal wall. Another signal transmission mode, the fluid propagation mode, occurs in a second frequency band when the fetus is in a recessed position with no direct contact with the maternal abdominal wall. The second frequency band is relatively higher than the first frequency band. The fetal heart monitoring system and method detect and process acoustic fetal heart signals that are in the first frequency band and in the second frequency band.

Official Gazette of the U.S. Patent and Trademark Office

Detection; Heart; Signal Transmission; Fetuses

20030053367 NASA Pasadena Office, CA, USA

Artificial Neural Network with Hardware Training and Hardware Refresh

Duong, Tuan A., Inventor; January 28, 2003; 11 pp.; In English

Patent Info.: Filed 1 Oct. 1999; US-Patent-6,513,023; US-Patent-Appl-SN-412199; NASA-Case-NPO-19289-1-CU; No Copyright; Avail: CASI; [A03](#), Hardcopy

A neural network circuit is provided having a plurality of circuits capable of charge storage. Also provided is a plurality of circuits each coupled to at least one of the plurality of charge storage circuits and constructed to generate an output in accordance with a neuron transfer function. Each of a plurality of circuits is coupled to one of the plurality of neuron transfer function circuits and constructed to generate a derivative of the output. A weight update circuit updates the charge storage circuits based upon output from the plurality of transfer function circuits and output from the plurality of derivative circuits. In preferred embodiments, separate training and validation networks share the same set of charge storage circuits and may operate concurrently. The validation network has a separate transfer function circuits each being coupled to the charge storage circuits so as to replicate the training network's coupling of the plurality of charge storage to the plurality of transfer function circuits. The plurality of transfer function circuits may be constructed each having a transconductance amplifier providing differential currents combined to provide an output in accordance with a transfer function. The derivative circuits may have a circuit constructed to generate a biased differential currents combined so as to provide the derivative of the transfer function.

Official Gazette of the U.S. Patent and Trademark Office

Circuits; Neural Nets; Hardware; Artificial Intelligence

20030053379 NASA Pasadena Office, CA, USA

Ultra-Sensitive Magnetoresistive Displacement Sensing Device

Olivas, John D., Inventor; Lairson, Bruce M., Inventor; Ramesham, Rajeshuni, Inventor; January 14, 2003; 9 pp.; In English
Patent Info.: Filed 24 Aug. 1999; US-Patent-6,507,187; US-Patent-Appl-SN-384363; NASA-Case-NPO-20146-1; No
Copyright; Avail: CASI; [A02](#), Hardcopy

An ultrasensitive displacement sensing device for use in accelerometers, pressure gauges, temperature transducers, and the like, comprises a sputter deposited, multilayer, magnetoresistive field sensor with a variable electrical resistance based on an imposed magnetic field. The device detects displacement by sensing changes in the local magnetic field about the magnetoresistive field sensor caused by the displacement of a hard magnetic film on a movable microstructure. The microstructure, which may be a cantilever, membrane, bridge, or other microelement, moves under the influence of an acceleration a known displacement predicted by the configuration and materials selected, and the resulting change in the electrical resistance of the MR sensor can be used to calculate the displacement. Using a micromachining approach, very thin silicon and silicon nitride membranes are fabricated in one preferred embodiment by means of anisotropic etching of silicon wafers. Other approaches include reactive ion etching of silicon on insulator (SOI), or Low Pressure Chemical Vapor Deposition of silicon nitride films over silicon substrates. The device is found to be improved with the use of giant magnetoresistive elements to detect changes in the local magnetic field.

Official Gazette of the U.S. Patent and Trademark Office

Displacement; Magnetoresistivity; Fabrication; Microelectromechanical Systems; Detection

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SPACE SCIENCES (GENERAL)

Includes general research topics related to the natural space sciences. For specific topics in space sciences see *categories 89 through 93*.

20030053339 NASA Kennedy Space Center, Cocoa Beach, FL, USA

STS-101 Meal - Suit Up - Depart O&C Launch - On Orbit - Landing - Crew Depart

May 29, 2000; In English

Report No.(s): KSC-45729; No Copyright; Avail: CASI; [V03](#), Videotape-VHS; [B03](#), Videotape-Beta

The STS-101 Space Shuttle Atlantis Assembly Flight International Space Station (ISS) -2A-2a mission begins with Commander Jim Halsell, and mission specialists Jeff Williams and Yuri Usachev talking briefly to the media. Pilot Scott Horowitz, and Mission Specialists Susan Helms, James Voss, and Mary Ellen Weber are shown arriving later to take crew photos. Footage of the entire STS-101 crew is shown getting suited and departing the Operations and Checkout (O&C) Building. Views of the actual launch of the Space Shuttle Atlantis are presented from the vehicle assembly building (VAB), PAD-A, Tower 1, Universal Camera Sites (UCS) 15 and 23 and Press sites. Jeff Williams and James Voss are shown on orbit performing a single space walk to complete maintenance to the International Space Station. A nighttime touchdown of the Space Shuttle Atlantis is also presented.

CASI

International Space Station; Atlantis (Orbiter); Spacecraft Launching; Space Transportation System; Spacecraft Landing

89

ASTRONOMY

Includes observations of celestial bodies; astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.

20030053175 NASA Goddard Space Flight Center, Greenbelt, MD, USA

A Fast Implementation of the ISOCLUS Algorithm

Memarsadeghi, Nargess; Mount, David M.; Netanyahu, Nathan S.; LeMoigne, Jacqueline; [2003]; 1 pp.; In English; IEEE 2003 International Geoscience and Remote Sensing Symposium, 21-25 Jul. 2003, Toulouse, France; Copyright; Avail: Other Sources; Abstract Only

Unsupervised clustering is a fundamental building block in numerous image processing applications. One of the most popular and widely used clustering schemes for remote sensing applications is the ISOCLUS algorithm, which is based on the ISODATA method. The algorithm is given a set of n data points in d-dimensional space, an integer k indicating the initial

number of clusters, and a number of additional parameters. The general goal is to compute the coordinates of a set of cluster centers in d-space, such that those centers minimize the mean squared distance from each data point to its nearest center. This clustering algorithm is similar to another well-known clustering method, called k-means. One significant feature of ISOCLUS over k-means is that the actual number of clusters reported might be fewer or more than the number supplied as part of the input. The algorithm uses different heuristics to determine whether to merge or split clusters. As ISOCLUS can run very slowly, particularly on large data sets, there has been a growing interest in the remote sensing community in computing it efficiently. We have developed a faster implementation of the ISOCLUS algorithm. Our improvement is based on a recent acceleration to the k-means algorithm of Kanungo, et al. They showed that, by using a kd-tree data structure for storing the data, it is possible to reduce the running time of k-means. We have adapted this method for the ISOCLUS algorithm, and we show that it is possible to achieve essentially the same results as ISOCLUS on large data sets, but with significantly lower running times. This adaptation involves computing a number of cluster statistics that are needed for ISOCLUS but not for k-means. Both the k-means and ISOCLUS algorithms are based on iterative schemes, in which nearest neighbors are calculated until some convergence criterion is satisfied. Each iteration requires that the nearest center for each data point be computed. Naively, this requires $O(kn)$ time, where k denotes the current number of centers. Traditional techniques for accelerating nearest neighbor searching involve storing the k centers in a data structure. However, because of the iterative nature of the algorithm, this data structure would need to be rebuilt with each new iteration. Our approach is to store the data points in a kd-tree data structure. The assignment of points to nearest neighbors is carried out by a filtering process, which successively eliminates centers that can not possibly be the nearest neighbor for a given region of space. This algorithm is significantly faster, because large groups of data points can be assigned to their nearest center in a single operation. Preliminary results on a number of real Landsat datasets show that our revised ISOCLUS-like scheme runs about twice as fast.

Author

Algorithms; Integers; Image Processing; Data Structures; Cluster Analysis

20030053176 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Evaluating Ground-based Proxies for Solar Irradiance Variation

Oegerle, William, Technical Monitor; Jordan, Stuart; [2003]; 1 pp.; In English; 34th Meeting of the AAS Solar Physics Division, 16-20 Jun. 2003, Laurel, MD, USA; No Copyright; Avail: Other Sources; Abstract Only

In order to determine what ground-based proxies are best for evaluating solar irradiance variation before the advent of space observations, it is necessary to test these proxies against space observations. We have tested sunspot number, total sunspot area, and sunspot umbral area against the Nimbus-7 measurements of total solar irradiance variation cover the eleven year period 1980-1990. The umbral area yields the best correlation and the total sunspot area yields the poorest. Reasons for expecting the umbral area to yield the best correlation are given, the statistical procedure followed to obtain the results is described, and the value of determining the best proxy is discussed. The latter is based upon the availability of an excellent database from the Greenwich Observatory obtained over the period 1876-1976, which can be used to estimate the total solar irradiance variation before sensitive space observations were available. The ground-based observations used were obtained at the Coimbra Solar Observatory. The analysis was done at Goddard using these data and data from the Nimbus-7 satellite.

Author

Evaluation; Ground Based Control; Solar Radiation; Sunspots; Light (Visible Radiation)

20030053177 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Far-IR/Submillimeter Interferometry Missions in NASA's Roadmap: SPIRIT and SPECS

Leisawitz, David T.; [2003]; 1 pp.; In English; Interferometry Seminar, May 6, 2003, Cambridge, MA, USA; No Copyright; Avail: Other Sources; Abstract Only

Information vital to the attainment of the major scientific objectives of NASA's Origins and Structure and Evolution of the Universe themes is uniquely available in the far-IR and submillimeter (FIR/SMM). NASA is studying concepts and investing in technologies for FIR/SMM observatories that could fly in the period 2010 - 2025 and provide enormous increases in measurement capabilities to extend the legacy of the next-generation missions SIRTf and Herschel. Future FIR/SMM space observatories will have the sensitivity needed to reach back in time to the formation epoch of the first luminous objects, the angular resolution needed to image proto-planetary systems and distinguish the emissions of individual galaxies, and the spectral resolution needed to probe the physical conditions and measure the flows of interstellar gas in young galaxies, nascent stars, and the dust-enshrouded nuclei of galaxies that harbor massive black holes. NASA's roadmap includes the JWST-class Single Aperture Far-IR (SAFIR) telescope and 1 km maximum-baseline FIR/SMM interferometer. This talk will focus on the niche for FIR/SMM interferometry and describe two missions: SPECS, the Submillimeter Probe of the Evolution of Cosmic Structure, and the pathfinder mission SPIRIT, the Space Infrared interferometric Telescope. I will give the scientific motivation

for these missions, describe mission concepts and telescope measurement capabilities, and compare these capabilities with those of the next-generation IR telescopes, and with the complementary JWST and ALMA.

Author

Far Infrared Radiation; Infrared Interferometers; Submillimeter Waves; Evolution (Development); Galactic Nuclei

20030053183 NASA Goddard Space Flight Center, Greenbelt, MD, USA, Space Telescope Science Inst., Baltimore, MD, USA

Excited Ejecta in Light of Sight from Eta Car

Vieira, G.; Gull, T. R.; Danks, A.; [2003]; 5 pp.; In English

Contract(s)/Grant(s): NAS5-26555; Copyright; Avail: CASI; [A01](#), Hardcopy

In the NUV spectrum of Eta Car, we have resolved many narrow absorption lines of neutral and singly-ionized elements with the Space Telescope Imaging Spectrograph. We report for the first time the detection of interstellar vanadium in absorption, and many highly-excited absorption lines of Fe, Cr, Ti, Ni, Co, Mn, and Mg. These elements, normally tied up in dust grains in the ISM, are located within wall of the Homunculus within 20,000 A.U. of Eta Car. Stellar radiation and stellar wind are interacting with the wall. Dust is likely being modified and/or destroyed. Previous Homunculus studies have demonstrated that nitrogen is overabundant and that carbon and oxygen emission lines are weak, or non-existent. Are the large column densities of these heavy elements due to abundance effects, excitation mechanisms, or modified grains? We may gain insight as Eta Car goes through its spectroscopic minimum in the summer of 2003.

Author

Variable Stars; Ultraviolet Spectra; Line Spectra; Ultraviolet Astronomy; Ejecta; Excitation; Absorption Spectra

20030053375 National Academy of Sciences - National Research Council, Greenbelt, MD, USA

Solar Flare Abundances of Potassium, Argon, and Sulphur

Oegerle, William, Technical Monitor; Phillips, K. J. H.; Sylwester, J.; Sylwester, B.; Landi, E.; [2003]; 2 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

The absolute coronal abundances of potassium has been determined for the first time from X-ray solar flare line and continuous spectra together with absolute and relative abundances of Ar and S. Potassium is of importance in the continuing debate concerning the nature of the coronal/photospheric element abundance ratios which are widely considered to depend on first ionization potential since it has the lowest FIP of any common element in the Sun. The measurements were obtained with the RESIK crystal spectrometer on the Coronas-F spacecraft. A differential emission measure $DEM = \text{const.} \times \exp(-(\beta)T(\text{sub } e))$ was found to be the most consistent with the data out of three models considered. We find that the coronal ratio $[K/H] = 3.7 \times 10(\exp - 7)$, a factor 3 times photospheric, in agreement with other observations using line-to-line ratios. Our measured value for the coronal ratio $[Ar/H] = 1.5 \times 10(\exp - 6)$ is significantly less than photospheric, indicating that there is a slight depletion of this high-FIP element in the corona. For S (an intermediate-FIP element) we obtained $[S/H] = 2.2 \times 10(\exp - 5)$, approximately the same as in previous work.

Author

Solar Flares; Potassium; Argon; Sulfur; Coronas; Abundance

20030053376 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Extra-Solar Planetary Imager (ESPI) for Space Based Jovian Planetary Detection

Lyon, Rick G.; Melnick, Gary J.; Nisenson, Peter; Papaliolios, Costa; Ridgeway, Steve; Friedman, Edward; Gezari, Dan Y.; Harwit, Martin; Graf, Paul; [2002]; 1 pp.; In English; SPIE Astronomical Telescope and Instrumentation Conference, 22-28 Aug. 2002, Kona, HI, USA; Copyright; Avail: Other Sources; Abstract Only

We report on our Extra-Solar Planetary Imager (ESPI) study for a recent Midex (NASA Medium Class Explorer Mission) proposal. Proposed for ESPI was a 1.5×1.5 square meter Jacquinot apodized square aperture telescope. The combination of apodization and a square aperture telescope significantly reduces the diffracted light from a bright central source over much of the telescope focal plane. As a result, observations of very faint astronomical objects next to bright sources with angular separations as small as 0.32 arcseconds become possible. This permits a sensitive search for exo-planets in reflected light. The system is capable of detecting a Jupiter-like planet in a relatively long-period orbit around as many as 160 to 175 stars with a signal-to-noise ratio greater than 5 in observations lasting maximally 100 hours per star. We discuss the effects of wavefront error, mirror speckle, pointing error and signal-to-noise issues, as well as the scalability of our ESPI study with respect to NASA's Terrestrial Planet Finder mission.

Author

Jupiter (Planet); Terrestrial Planets; Telescopes; Planet Detection; Spaceborne Astronomy; NASA Space Programs; Imaging Techniques

20030053381 NASA Goddard Space Flight Center, Greenbelt, MD, USA

UV Spectral Templates for High-Redshift Galaxies

Heap, Sara; Lindler, Don; Lanz, Thierry; [2003]; 1 pp.; In English; 202nd Meeting of the American Astronomical Society, 25-29 May 2003, Nashville, TN, USA; Copyright; Avail: Other Sources; Abstract Only

New instrumentation such as DEIMOS on Keck-II now enable deep spectral surveys, and thereby samples of galaxies at younger ages. At a redshift, $z = 1$, all galaxies are less than 6 Gyr old and hence, have not yet formed horizontal-branch stars. Also, at $z = 1$, the restframe-UV comes into view, and with it, a new set of spectral diagnostics. UV spectral features are especially important because most of the UV flux comes from stars at the main-sequence turnoff (MSTO). Hence, UV spectral diagnostics enable the ages of $z = 1$ galaxies to be estimated directly from MSTO stars. In preparation for these high-redshift spectral surveys, we are developing UV spectral templates for stellar populations younger than 6 Gyr using UV-optical spectra of stars observed by HST/STIS. We are also planning to supplement these observations with theoretical spectral grids of stars of various metallicities. In this paper, we present a progress report on the observation-based spectral templates and spectral diagnostics.

Author

Galaxies; Red Shift; Ultraviolet Spectra; Stellar Spectra; Observation

20030053387 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Precision Pointing for the Laser Interferometry Space Antenna Mission

Hyde, T. Tupper; Bauer, Frank H., Technical Monitor; February 03, 2003; 57 pp.; In English; IFAC/AIAA/AAS Workshop on Telescope Control, 2-5 Feb. 2003, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; [A04](#), Hardcopy

This viewgraph presentation discusses requirements for control systems in the design and production of space-based telescopes. Specific topics covered include: pointing control methods, wavefront control methods, vibration control methods and thermal control methods. Control systems on the Hubble Space Telescope and the James Webb Space Telescope are reviewed. Control system requirements for future space telescopes are also mentioned.

CASI

Pointing Control Systems; Spaceborne Telescopes; Control Systems Design; Optical Equipment; Design Analysis; Systems Analysis

20030053390 NASA Goddard Space Flight Center, Greenbelt, MD, USA

First Year Wilkinson Microwave Anisotropy Probe(WMAP) Observations: Data Processing Methods and Systematic Errors Limits

Hinshaw, G.; Barnes, C.; Bennett, C. L.; Greason, M. R.; Halpern, M.; Hill, R. S.; Jarosik, N.; Kogut, A.; Limon, M.; Meyer, S. S., et al.; [2003]; 56 pp.; In English; Copyright; Avail: CASI; [A04](#), Hardcopy

We describe the calibration and data processing methods used to generate full-sky maps of the cosmic microwave background (CMB) from the first year of Wilkinson Microwave Anisotropy Probe (WMAP) observations. Detailed limits on residual systematic errors are assigned based largely on analyses of the flight data supplemented, where necessary, with results from ground tests. The data are calibrated in flight using the dipole modulation of the CMB due to the observatory's motion around the Sun. This constitutes a full-beam calibration source. An iterative algorithm simultaneously fits the time-ordered data to obtain calibration parameters and pixelized sky map temperatures. The noise properties are determined by analyzing the time-ordered data with this sky signal estimate subtracted. Based on this, we apply a pre-whitening filter to the time-ordered data to remove a low level of $1/f$ noise. We infer and correct for a small (approx. 1 %) transmission imbalance between the two sky inputs to each differential radiometer, and we subtract a small sidelobe correction from the 23 GHz (K band) map prior to further analysis. No other systematic error corrections are applied to the data. Calibration and baseline artifacts, including the response to environmental perturbations, are negligible. Systematic uncertainties are comparable to statistical uncertainties in the characterization of the beam response. Both are accounted for in the covariance matrix of the window function and are propagated to uncertainties in the final power spectrum. We characterize the combined upper limits to residual systematic uncertainties through the pixel covariance matrix.

Author

Data Processing; Microwave Anisotropy Probe; Calibrating; Cosmic Microwave Background Radiation; Sky Surveys (Astronomy); Systematic Errors

20030053393 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Mid-Infrared Imaging of Orion BN/KL With Keck I Telescope

Oegerle, William, Technical Monitor; Gezari, Daniel; Danchi, William; [2003]; 2 pp.; In English; International Astronomical Union Conference, 13-26 Jul. 2003, Sydney, Australia; No Copyright; Avail: Other Sources; Abstract Only

We present new images of the Orion BN/KL infrared complex at 4.8, 8.0, 8.9, 9.9, 10.4, 11.7, 12.5, 17.6, 18.1, 20.0 and 22.0 microns obtained with the 10-meter Keck I telescope, with typically 0.3 arcsec resolution at 12.5 microns. The multi-wavelength observational image data is registered in a stack and a dust emission/extinction model is fitted to the resulting spectrum of each pixel to create a diffraction-limited 'image' of the temperature, opacity and luminosity of the emitting dust, as well as the circumstellar and line-of-sight dust extinction. New source structure, temperature, opacity and luminosity detail is seen in the vicinity of IRC2-IRC7. The model results are used to develop a more complete picture of the structure and energetics of the BN/KL infrared complex.

Author

Imaging Techniques; Infrared Radiation; Orion Nebula; Data Acquisition

20030053409 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Heterodyne Receiver Requirements for the Single Aperture Far-Infrared (SAFIR) Observatory

Benford, Dominic J.; Kooi, Jacob; Oegerle, William, Technical Monitor; [2003]; 1 pp.; In English; 14th International TeraHertz Conference, 21-24 Apr. 2003, Tucson, AZ, USA; Copyright; Avail: Other Sources; Abstract Only

In the next few years, work will commence in earnest on the development of technology for the next generation large cryogenic far-infrared telescope: the Single Aperture Far-Infrared (SAFIR) Observatory. SAFIR's science goals are driven by the fact that youngest stages of almost all phenomena in the universe are shrouded in absorption by cool dust, resulting in the energy being emitted primarily in the far-infrared. The earliest stages of star formation, when gas and dust clouds are collapsing and planets forming, can only be observed in the far-infrared. Spectral diagnostics in the far-infrared are typically quite narrow (approx. 1 km/s) and require high sensitivity to detect them. SAFIR is a 10 m-class telescope designed for cryogenic operation at L2, removing all sources of thermal emission from the telescope and atmosphere. Despite its limited collecting area and angular resolution as compared to the ALMA interferometer, its potential for covering the entire far-infrared band cannot be matched by any ground-based or airborne observatory. This places a new challenge on heterodyne receivers: broad frequency coverage. The ideal mixer would be able to detect frequencies over several octaves (e.g., 0.6 THz - 12 THz) with near quantum-limited performance at all frequencies. In contrast to ground-based observatories, it may not be necessary to strive for high instantaneous bandwidth, as direct detection spectroscopy is preferable for bandwidths of $\Delta \nu / \nu$ greater than or equal to $10(\exp -4)$ (e.g., 1 GHz at 10 THz). We consider likely directions for technology development for heterodyne receivers for SAFIR.

Author

Heterodyning; Receivers; Far Infrared Radiation; Infrared Astronomy; Spaceborne Telescopes

20030053418 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Science Highlights from the First Year of Advanced Camera for Surveys

Clampin, M.; Ford, H. C.; Illingworth, G. D.; Hartig, G.; Ardila, D. R.; Blakeslee, J. P.; Bouwens, R. J.; Cross, N. J. G.; Feldman, P. D.; Golimowski, D. A., et al.; [2003]; 1 pp.; In English; American Astronomical Society Conference, May 2003, Nashville, TN, USA; Copyright; Avail: Other Sources; Abstract Only

The Advanced Camera for Surveys (ACS) is a deep imaging camera installed on the Hubble Space Telescope during the fourth HST servicing mission. ACS recently entered its second year of science operations and continues to perform beyond pre-launch expectations. We present science highlights from the ACS Science Team's GTO program. These highlights include the evolution of z approx. 6 galaxies from deep imaging observations; deep imaging of strongly lensed clusters which have been used to determine cluster mass, and independently constraint the geometry of the Universe; and coronagraphic observations of debris disks.

Author

Cameras; Imaging Techniques; Astronomical Photography; Gravitational Lenses; Spaceborne Photography

20030053431 NASA Goddard Space Flight Center, Greenbelt, MD, USA

First Year Wilkinson Microwave Anisotropy Probe(WMAP)Observations: The Angular Power Spectrum

Hinshaw, G.; Spergel, D. N.; Verde, L.; Hill, R. S.; Meyer, S. S.; Barnes, C.; Bennett, C. L.; Halpern, M.; Jarosik, N.; Kogut, A.; [2003]; 43 pp.; In English

Contract(s)/Grant(s): NAS8-39073; PF2-30022; Copyright; Avail: CASI; [A03](#), Hardcopy

We present the angular power spectrum derived from the first-year Wilkinson Microwave Anisotropy Probe (WMAP) sky maps. We study a variety of power spectrum estimation methods and data combinations and demonstrate that the results are robust. The data are modestly contaminated by diffuse Galactic foreground emission, but we show that a simple Galactic template model is sufficient to remove the signal. Point sources produce a modest contamination in the low frequency data. After masking approximately 700 known bright sources from the maps, we estimate residual sources contribute approximately $3500 \mu\text{sq K}$ at 41 GHz, and approximately $130 \mu\text{sq K}$ at 94 GHz, to the power spectrum $[\ell(\ell+1)C(\ell)/2\pi]$ at $\ell = 1000$. Systematic errors are negligible compared to the (modest) level of foreground emission. Our best estimate of the power spectrum is derived from 28 cross-power spectra of statistically independent channels. The final spectrum is essentially independent of the noise properties of an individual radiometer. The resulting spectrum provides a definitive measurement of the CMB power spectrum, with uncertainties limited by cosmic variance, up to ℓ approximately 350. The spectrum clearly exhibits a first acoustic peak at $\ell = 220$ and a second acoustic peak at ℓ approximately 540, and it provides strong support for adiabatic initial conditions. Researchers have analyzed the ℓ (sup Epsilon) power spectrum, and present evidence for a relatively high optical depth, and an early period of cosmic reionization. Among other things, this implies that the temperature power spectrum has been suppressed by approximately 30% on degree angular scales, due to secondary scattering.

Author

Cosmic Microwave Background Radiation; Cosmology; Galactic Evolution; Universe; Power Spectra; Acoustics; Sky Surveys (Astronomy); Radio Astronomy

20030053453 NASA Goddard Space Flight Center, Greenbelt, MD, USA

First Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Preliminary Maps and Basic Results

Bennett, C. L.; Halpern, M.; Hinshaw, G.; Jarosik, N.; Kogut, A.; Limon, M.; Meyer, S. S.; Page, L.; Spergel, D. N.; Tucker, G. S., et al.; [2003]; 40 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; [A03](#), Hardcopy

We present full sky microwave maps in five frequency bands (23 to 94 GHz) from the WMAP first year sky survey. Calibration errors are less than 0.5% and the low systematic error level is well specified. The cosmic microwave background (CMB) is separated from the foregrounds using multifrequency data. The sky maps are consistent with the 7 in. full-width at half-maximum (FWHM) Cosmic Background Explorer (COBE) maps. We report more precise, but consistent, dipole and quadrupole values. The CMB anisotropy obeys Gaussian statistics with χ^2 less than 58 less than $f(\text{sub NL})$ less than 134 (95% CL). The 2ℓ less than or $= 1$ less than or $= 900$ anisotropy power spectrum is cosmic variance limited for ℓ less than 354 with a signal-to-noise ratio greater than 1 per mode to $\ell = 658$. The temperature-polarization cross-power spectrum reveals both acoustic features and a large angle correlation from reionization. The optical depth of reionization is $\tau = 0.17 \pm 0.04$, which implies a reionization epoch of $t(\text{sub r}) = 180(\text{sup } +220, \text{sub } -80)$ Myr (95% CL) after the Big Bang at a redshift of $z(\text{sub r}) = 20(\text{sup } +10, \text{sub } -9)$ (95% CL) for a range of ionization scenarios. This early reionization is incompatible with the presence of a significant warm dark matter density. A best-fit cosmological model to the CMB and other measures of large scale structure works remarkably well with only a few parameters. The age of the best-fit universe is $t(\text{sub 0}) = 13.7 \pm 0.2$ Gyr old. Decoupling was $t(\text{sub dec}) = 379(\text{sup } +8, \text{sub } -7)$ kyr after the Big Bang at a redshift of $z(\text{sub dec}) = 1089 \pm 1$. The thickness of the decoupling surface was $\Delta(\text{sub } z(\text{sub dec})) = 195 \pm 2$. The matter density of the universe is $\Omega(\text{sub m})h(\text{sup } 2) = 0.135(\text{sup } +0.008, \text{sub } -0.009)$ the baryon density is $\Omega(\text{sub b})h(\text{sup } 2) = 0.0224 \pm 0.0009$, and the total mass-energy of the universe is $\Omega(\text{sub tot}) = 1.02 \pm 0.02$. There is progressively less fluctuation power on smaller scales, from WMAP to fine scale CMB measurements to galaxies and finally to the Ly-alpha forest. This is accounted for with a running spectral index, significant at the approx. $2(\sigma)$ level. The spectral index of scalar fluctuations is fit as $n(\text{sub s}) = 0.93 \pm 0.03$ at wavenumber $k(\text{sub o}) = 0.05/\text{Mpc}$ ((sub eff) approx. = 700), with a slope of $dn(\text{sub s})/d\ln(k) = -0.031(\text{sup } +0.016, \text{sub } -0.018)$ in the best-fit model.

Author

Microwave Anisotropy Probe; Mapping; Data Acquisition; Sky Surveys (Astronomy); Systematic Errors

20030054353 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Monitoring and Detecting X-ray Transients with the Swift Observatory

Markwardt, Craig; [2002]; 1 pp.; In English; MIT X-ray Binaries Conference, 14-15 Nov. 2002; No Copyright; Avail: Other Sources; Abstract Only

Swift is a multi-wavelength observatory specifically designed to detect transient sources in the gamma-ray energy band 15-200 keV. The primary goals of the mission involve gamma ray burst (GRB) astronomy, namely to determine the origin of GRBs and their afterglows, and use bursts to probe the early Universe. However, Swift will also discover new X-ray transient

sources, and it will be possible to bring Swift's considerable multi-wavelength capabilities to bear on these sources, and those discovered by other means. The Burst Alert Telescope (BAT) is a coded mask instrument sensitive to 15-200 keV gamma rays, and has a field of view which covers approximately 1/8th of the sky in a single pointing. Over a typical observing day, the almost the entire sky will be observed and monitored for new transient sources. Sources will be detected within several hours of observation. The two narrow field instruments, the X-ray Telescope and Ultra-Violet Optical Telescope, can provide sensitive simultaneous imaging and spectroscopy observations in the optical through soft X-ray bands. The Swift science operations team will entertain requests for targets of opportunity for sources which are astrophysically significant. Swift will be ideally suited for the detection of transients which produce hard X-rays, such as black hole binaries and some neutron star systems.

Author

Astronomical Observatories; Gamma Ray Bursts; X Ray Sources; Gamma Ray Astronomy; Gamma Ray Sources (Astronomy); Spaceborne Telescopes

20030054369 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Investigation of Spectral Lag and Epeak as Joint Luminosity Indicators in GRBs

White, Nicholas E., Technical Monitor; Norris, Jay P.; [2003]; 1 pp.; In English; AAS Meeting, 5-10 Jan. 2003, Seattle, WA, USA; No Copyright; Avail: Other Sources; Abstract Only

Models for gamma-ray bursts which invoke jetted, colliding shells would appear to have at least two determinants for luminosity, e.g., observer viewing angle and Lorentz factor, or possibly shell mass. The latter two internal physical parameters may vary from pulse to pulse within a burst, and such variation might be reflected in evolution of observables such as spectral lag and peak in the spectral energy distribution. We analyze bright BATSE bursts using the 16-channel medium energy resolution (MER) data, with time resolutions of 16 and 64 ms, measuring spectral lags and peak energies for significant pulse structures within a burst, identified using a Bayesian block algorithm. We then explore correlations between the measured parameters and total flux for the individual pulse structures.

Author

Gamma Ray Bursts; Astronomical Models; Luminosity; Spectral Energy Distribution

20030054371 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Accretion Disk Spectra of the Ultra-luminous X-ray Sources in Nearby Spiral Galaxies and Galactic Superluminal Jet Sources

White, Nicholas E., Technical Monitor; Ebisawa, Ken; Zycki, Piotr; Kubota, Aya; Mizuno, Tsunefumi; Watarai, Ken-ya; April 29, 2003; 36 pp.; In English; Copyright; Avail: CASI; [A03](#), Hardcopy

Ultra-luminous Compact X-ray Sources (ULXs) in nearby spiral galaxies and Galactic superluminal jet sources share the common spectral characteristic that they have unusually high disk temperatures which cannot be explained in the framework of the standard optically thick accretion disk in the Schwarzschild metric. On the other hand, the standard accretion disk around the Kerr black hole might explain the observed high disk temperature, as the inner radius of the Kerr disk gets smaller and the disk temperature can be consequently higher. However, we point out that the observable Kerr disk spectra becomes significantly harder than Schwarzschild disk spectra only when the disk is highly inclined. This is because the emission from the innermost part of the accretion disk is Doppler-boosted for an edge-on Kerr disk, while hardly seen for a face-on disk. The Galactic superluminal jet sources are known to be highly inclined systems, thus their energy spectra may be explained with the standard Kerr disk with known black hole masses. For ULXs, on the other hand, the standard Kerr disk model seems implausible, since it is highly unlikely that their accretion disks are preferentially inclined, and, if edge-on Kerr disk model is applied, the black hole mass becomes unreasonably large (greater than or approximately equal to 300 Solar Mass). Instead, the slim disk (advection dominated optically thick disk) model is likely to explain the observed super-Eddington luminosities, hard energy spectra, and spectral variations of ULXs. We suggest that ULXs are accreting black holes with a few tens of solar mass, which is not unexpected from the standard stellar evolution scenario, and their X-ray emission is from the slim disk shining at super-Eddington luminosities.

Author

Accretion Disks; X Ray Sources; High Temperature; Black Holes (Astronomy); Spiral Galaxies

20030054381 NASA Goddard Space Flight Center, Greenbelt, MD, USA

STIS Spectroscopy of the Lyman-Alpha Forest Toward 3C 273

Heap, Sara R.; Williger, Gerard; [2002]; 1 pp.; In English; The Intergalactic Medium/Galaxy Connection: The Distribution of Baryons at $z=0$, 8-10 Aug. 2002, Boulder, CO, USA; Copyright; Avail: Other Sources; Abstract Only

We present results on the low-redshift Lyman-alpha forest as based on high-resolution (7 km/s) STIS spectra of 3C 273. A total of 121 intergalactic Lyman-alpha-absorbing systems were detected, of which 60 are above the 3.5sigma completeness limit, $\log N(\text{sub HI})$ approximately equals 12.3. The median line-width parameter, $b = 27$ km/s, is similar to that seen at high redshift. However the distribution of HI column densities has a steeper slope, $\beta = 2.02 \pm 0.21$, than is seen at high redshift. Overall, the observed $N(\text{sub HI})$ - b distribution is consistent with that derived from a Λ CDM hydrodynamic simulation. We have used NED to compile a list of 300 galaxies (91 from SDSS, 98 from APM) within 1 Mpc of the line of sight to 3C 273 and are working to find line-of-sight velocity correlations between the galaxies and detected Lyman-alpha absorbers.

Author

Red Shift; Lyman Alpha Radiation; Spectroscopy

20030054388 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Groundbased Observations of Io [OI]6300 Å Emission During the Galileo 124, 125, and Cassini Encounters

Oliversen, R. J.; Morgenthaler, J. P.; Scherb, F.; Woodward, R. C.; Smyth, W. H.; Lupie, O. L.; [2003]; 1 pp.; In English; AGU Fall Meeting, 6-10 Dec. 2002, San Francisco, CA, USA; Copyright; Avail: Other Sources; Abstract Only

For the past 12 years, we have conducted a synoptic study of [OI] 6300 Å emission from Io using the high-resolution (R 120,000) stellar spectrograph at the National Solar Observatory McMath-Pierce telescope. We showed in a recent paper that this emission allows us to use Io as a localized probe of the three-dimensional plasma torus structure. We report on selected recent spectroscopic observations of Io [OI] 6300 Å emission obtained during the Galileo I24 (1999-Oct-11) and I25 (1999-Nov-26) encounters with Io and the Cassini Jupiter encounter (closest approach 2000-Dec-30). The exposure time for each spectrum was 15 minutes, with a 5.2×5.2 aperture centered on Io. We obtained over 100 spectra for the I24 encounter during 1999 October 9-13, over 100 spectra for the I25 encounter during 1999 November 24-30, and for the Cassini Jupiter flyby almost 600 spectra from 2000 December to 2001 January 21. We use our database of observations to track long- and short-term variations in torus structure. We compare our results to Galileo, Cassini, HST, and other groundbased contemporaneous observations to gain insight into torus variability and structure.

Author

Toroidal Plasmas; Io; Spectroscopic Analysis; Three Dimensional Models

20030054397 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Young, Massive Stars at Low Metallicity

Oegerle, William R., Technical Monitor; Heap, S. R.; Lanz, T.; [2002]; 1 pp.; In English; 200th Meeting of the American Astronomical Society, 2-6 Jun. 2002, Albuquerque, NM, USA; No Copyright; Avail: CASI; [A01](#), Hardcopy; Abstract Only

We report on an extensive analysis of O-type stars in the Small Magellanic Cloud that have been observed by HST and FUSE. The analysis, which involves detailed NLTE atmospheric models recently constructed by Lanz & Hubeny, has the following goals: (1) calibration of spectral properties in terms of fundamental parameters; (2) resolution of the discrepancy between spectroscopic masses and evolutionary masses; and (3) evidence for mixing of nuclear-processed elements. We derive a significantly lower temperature scale for O-type stars than previously assumed; the lower temperatures help to resolve the mass discrepancy. We describe the results of our analysis and discuss their implications for stellar evolution at low metallicity.

Author

O Stars; Atmospheric Models; Spectroscopic Analysis; Metallicity

20030054475 Colorado Univ., Boulder, CO, USA

Studies for Improved Gravitational Wave Sensitivity

Bender, Peter L.; May 05, 2003; 3 pp.; In English

Contract(s)/Grant(s): NAG5-10259; No Copyright; Avail: CASI; [A01](#), Hardcopy

The main purpose of this study was to investigate the possible accuracy of the Laser Interferometer Space Antenna (LISA) for studying gravitational waves at frequencies below the usually quoted frequency range of 100 microHz to 1 Hz. The extended frequency range of most interest is from 3 to 100 microHz. During this work, a new source of spurious accelerations of the test masses for LISA that had been overlooked previously was identified. It is one of the main noise contributors at 100 microHz, and rises as the inverse of the frequency to become probably the largest error source at 3 microHz. The new error source is fluctuations in the charge on the test mass due to cosmic ray charging interacting with the electric fields inside the housing that carries the capacitive electrodes for sensing relative motion of the test mass with respect to the housing. Even

for zero charge on the test mass, there will be electrical fields acting on each face due to work function differences between the capacitive electrodes and the test mass.

Author

Lisa (Observatory); Gravitational Waves; Sensitivity; Acceleration (Physics); Noise Generators; Magnetic Variations

20030054477 NASA Ames Research Center, Moffett Field, CA, USA

Terrestrial Planet Formation in Binary Star Systems

Lissauer, Jack J.; Quintana, Elisa V.; Chambers, John; Duncan, Martin J.; Adams, Fred; [2003]; 1 pp.; In English; 19th IAP Conference 2003: Extra Solar Planets: Today and Tomorrow, 30 Jun. - 4 Jul. 2003, Paris, France

Contract(s)/Grant(s): RTOP 274-52-02-57

Report No.(s): Rept-1; No Copyright; Avail: Other Sources; Abstract Only

Most stars reside in multiple star systems; however, virtually all models of planetary growth have assumed an isolated single star. Numerical simulations of the collapse of molecular cloud cores to form binary stars suggest that disks will form within such systems. Observations indirectly suggest disk material around one or both components within young binary star systems. If planets form at the right places within such circumstellar disks, they can remain in stable orbits within the binary star systems for eons. We are simulating the late stages of growth of terrestrial planets within binary star systems, using a new, ultrafast, symplectic integrator that we have developed for this purpose. We show that the late stages of terrestrial planet formation can indeed take place in a wide variety of binary systems and we have begun to delineate the range of parameter space for which this statement is true. Results of our initial simulations of planetary growth around each star in the alpha Centauri system and other 'wide' binary systems, as well as around both stars in very close binary systems, will be presented.

Author

Binary Stars; Planetary Evolution; Star Formation; Terrestrial Planets

20030054491 NASA Ames Research Center, Moffett Field, CA, USA

Anharmonic Vibrational Spectroscopy of the F-(H₂O)_n complexes, n=1,2

Chaban, Galina M.; Xantheas, Sotiris; Gerber, R. Benny; Kwak, Dochan, Technical Monitor; April 2, 2003; 22 pp.; In English

Contract(s)/Grant(s): RTOP 274-50-00-06; Copyright; Avail: CASI; [A03](#), Hardcopy

We report anharmonic vibrational spectra (fundamentals, first overtones) for the F-(H₂O) and F-(H₂O)₂ clusters computed at the MP2 and CCSD(T) levels of theory with basis sets of triple zeta quality. Anharmonic corrections were estimated via the correlation-corrected vibrational self-consistent field (CC-VSCF) method. The CC-VSCF anharmonic spectra obtained on the potential energy surfaces evaluated at the CCSD(T) level of theory are the first ones reported at a correlated level beyond MP2. We have found that the average basis set effect (TZP vs. aug-cc-pVTZ) is on the order of 30-40 cm(exp -1), whereas the effects of different levels of electron correlation [MP2 vs. CCSD(T)] are smaller, 20-30 cm(exp -1). However, the basis set effect is much larger in the case of the H-bonded O-H stretch of the F-(H₂O) cluster amounting to 100 cm(exp -1) for the fundamentals and 200 cm (exp -1) for the first overtones. Our calculations are in agreement with the limited available set of experimental data for the F-(H₂O) and F-(H₂O)₂ systems and provide additional information that can guide further experimental studies.

Author

Vibrational Spectra; Harmonics; Spectral Correlation; Vibration; Frequencies; Spectral Bands

20030054516 Smithsonian Astrophysical Observatory, Cambridge, MA, USA

Clump Giants in the Hyades

Mushotzky, Richard F., Technical Monitor; Brickhouse, Nancy; May 2003; 2 pp.; In English

Contract(s)/Grant(s): NAG5-9986; No Copyright; Avail: Other Sources; Abstract Only

The project is entitled 'Clump Giants in the Hyades.' This observation of one of the late-type Hyades giants (Gamma Tau) has implications for understanding the formation of late-type stellar coronae as a function of the evolutionary state of the star. The Hyades giants are interesting because they are all clump giants in the Helium burning phase, similar to the cool primary of Capella. The Hyades giants show significantly more magnetic activity than expected from their state of evolution (and slowed-down rotation). Thus these systems provide an important clue to dynamo action. The data were obtained by the satellite on 13 March 2001 for a total RGS exposure of 58220 seconds. These data were delivered to the PI on 7 August 2001. The data could not be reprocessed until SAS Version 5.3.3 which became available 7 June 2002. Although the guidelines for assessing background rates suggested that half the data were contaminated, it does not appear that the spectral region of the RGS was adversely affected by unusually high background. The spectra show strong lines of Fe XVII and XVIII, O VII and

VIII, Ne IX and X, along with numerous weaker lines. The emission measure distribution is highly reminiscent of Capella; if anything, the emission measure distribution is steeper at 6 million K than for Capella. Gamma Tau is the second brightest of the Hyades clump giants. Pallavicini et al. have shown that the luminosity of the brightest Hyades giant (Theta Tau) is remarkably similar to its luminosity as measured by Einstein. Short-term variability is also modest. We are addressing the variability issue now for Gamma Tau. Initial results were reported at the 2003 Seattle AAS meeting. A paper is in preparation for submission to the Astrophysical Journal.

Author

Giant Stars; Stellar Coronas; Stellar Evolution; X Ray Astronomy; X Ray Spectroscopy

20030054558 Hawaii Univ., Honolulu, HI, USA

Hard X-Rays from a Complete Sample of the Brightest Ultraluminous Infrared Galaxies

Sanders, David B.; May 27, 2003; 3 pp.; In English

Contract(s)/Grant(s): NAG5-10025; No Copyright; Avail: CASI; [A01](#), Hardcopy

We were awarded 70kS of XMM-Newton spacecraft time using the Epic pn camera to observe three ultraluminous infrared galaxies (ULIGs) in order to measure the spectral shape of their hard X-Ray emission, and to use this information to search for the presence of an highly obscured active galactic nucleus (AGN), and to separate out the contributions from a putative starburst. By observing three objects we hope to be able to better assess the role of AGN in the complete class of ULIGs and therefore to better constrain their contribution to the X-ray background. XMM-Newton was deemed to be better suited to our proposed measurements of ULIGs than the Chandra X-ray observatory due to its larger aperture and better sensitivity to hard (2-10 keV) X-rays.

Author

Infrared Radiation; Stellar Luminosity; Active Galactic Nuclei; X Ray Astronomy; Brightness Distribution

90

ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

20030053182 NASA Goddard Space Flight Center, Greenbelt, MD, USA

First Results From the Wilkinson Microwave Anisotropy Probe (WMAP)

Bennett, Charles; Oegerle, William, Technical Monitor; [2003]; 1 pp.; In English; Fermilab Colloquium, 1-2 Apr. 2003; No Copyright; Avail: CASI; [A01](#), Hardcopy

The first findings from a year of WMAP satellite operations provide a detailed full sky map of the cosmic microwave background radiation. The observed temperature anisotropy, combined with the associated polarization information, encodes a wealth of cosmological information. The results have implications for the history, content, and evolution of the universe, and its large scale properties. These and other aspects of the mission will be discussed.

Author

Microwave Anisotropy Probe; Sky Surveys (Astronomy); Mapping; Cosmic Microwave Background Radiation

20030053374 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Relativistic and Slowing Down: The Flow in the Hotspots of Powerful Radio Galaxies and Quasars

Kazanas, D.; [2003]; 1 pp.; In English; 2003 High Energy Astrophysics Division (HEAD); No Copyright; Avail: Other Sources; Abstract Only

The 'hotspots' of powerful radio galaxies (the compact, high brightness regions, where the jet flow collides with the intergalactic medium (IGM)) have been imaged in radio, optical and recently in X-ray frequencies. We propose a scheme that unifies their, at first sight, disparate broad band (radio to X-ray) spectral properties. This scheme involves a relativistic flow upstream of the hotspot that decelerates to the sub-relativistic speed of its inferred advance through the IGM and it is viewed at different angles to its direction of motion, as suggested by two independent orientation estimators (the presence or not of broad emission lines in their optical spectra and the core-to-extended radio luminosity). This scheme, besides providing an account of the hotspot spectral properties with jet orientation, it also suggests that the large-scale jets remain relativistic all the way to the hotspots.

Author

Relativistic Effects; Radio Galaxies; Quasars; Jet Flow; Intergalactic Media; Broadband; Radio Astronomy; X Ray Astronomy

20030053384 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Intermediate Element Abundances In Galaxy Clusters

White, Nicholas E., Technical Monitor; Baumgartner, W. H.; Loewenstein, M.; Horner, D. L.; Mushotzky, R. F.; [2003]; 1 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

We present the average abundances of the intermediate elements obtained by performing a stacked analysis of all the galaxy clusters in the archive of the X-ray telescope AKA. We determine the abundances of Fe, Si, S, and Ni as a function of cluster temperature (mass) from 1 - 10 keV, and place strong upper limits on the abundances of Ca and Ar. In general, Si and Ni are overabundant with respect to Fe, while Ar and Ca are very underabundant. The discrepancy between the abundances of Si, S, Ar, and Ca indicate that the alpha-elements do not behave homogeneously as a single group. We show that the abundances of the most well-determined elements Fe, Si, and S in conjunction with recent theoretical supernovae yields do not give a consistent solution for the fraction of material produced by Type Ia and Type II supernovae at any temperature or mass. The general trend is for higher temperature clusters to have more of their metals produced in Type II supernovae than in Type Ias. The inconsistency of our results with abundances in the Milky Way indicate that spiral galaxies are not the dominant metal contributors to the intracluster medium (ICM). The pattern of elemental abundances requires an additional source of metals beyond standard SNIa and SNII enrichment. The properties of this new source are well matched to those of Type II supernovae with very massive, metal-poor progenitor stars. These results are consistent with a significant fraction of the ICM metals produced by an early generation of population III stars.

Author

Galactic Clusters; Chemical Composition; X Ray Astronomy; Metallicity; Temperature Dependence

20030053416 NASA Goddard Space Flight Center, Greenbelt, MD, USA

WMAP: A Glimpse of the Early Universe

Oegerle, William J., Technical Monitor; Wollack, Edward; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

The early Universe was incredibly hot, dense, and homogeneous. A powerful probe of this time is provided by the relic radiation which we refer to today as the Cosmic Microwave Background (CMB). Images produced from this light contain the earliest glimpse of the Universe after the 'Big Bang' and the signature of the evolution of its contents. By exploiting these clues, precise constraints on the age, mass density, and geometry of the early Universe can be derived. Recent results from NASA's Wilkinson Microwave Anisotropy Probe (WMAP) will be presented.

Author

Cosmic Microwave Background Radiation; Relic Radiation; Microwave Anisotropy Probe

20030053441 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Taking the Measure of the Universe: Cosmology from the WMAP Mission

Hinshaw, Gary; Oegerle, William, Technical Monitor; [2003]; 1 pp.; In English; Talk at Stanford University, 5-8 Apr. 2003, Stanford, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

The data from the first year of operation of the Wilkinson Microwave Anisotropy Probe (WMAP) satellite provide the first detailed full sky map of the cosmic microwave background radiation. The anisotropy in the radiation temperature provides a wealth of cosmological information, including the age of the universe, the epoch when the first stars formed, and the overall composition of baryonic matter, dark matter, and dark energy. The results also provide constraints on the period of inflationary expansion in the very first moments of time. These and other aspects of the mission will be discussed. The WMAP satellite was built in a close partnership between Princeton University and the Goddard Space Flight Center.

Author

Cosmology; Microwave Anisotropy Probe; Universe; Space Missions

20030053451 NASA Goddard Space Flight Center, Greenbelt, MD, USA

First Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Foreground Emission

Bennett, C. L.; Hill, R. S.; Hinshaw, G.; Nolte, M. R.; Odegard, N.; Page, L.; Spergel, D. N.; Weiland, J. L.; Wright, E. L.; Halpern, M.; [2003]; 39 pp.; In English; Original contains black and white illustrations; Copyright; Avail: CASI; [A03](#), Hardcopy

The WMAP mission has mapped the full sky to determine the geometry, content, and evolution of the universe. Full sky maps are made in five microwave frequency bands to separate the temperature anisotropy of the cosmic microwave background (CMB) from foreground emission, including diffuse Galactic emission and Galactic and extragalactic point

sources. We define masks that excise regions of high foreground emission, so CMB analyses can be carried out with minimal foreground contamination. We also present maps and spectra of the individual emission components, leading to an improved understanding of Galactic astrophysical processes. The effectiveness of template fits to remove foreground emission from the WMAP data is also examined. These efforts result in a CMB map with minimal contamination and a demonstration that the WMAP CMB power spectrum is insensitive to residual foreground emission. We use a Maximum Entropy Method to construct a model of the Galactic emission components. The observed total Galactic emission matches the model to less than 1% and the individual model components are accurate to a few percent. We find that the Milky Way resembles other normal spiral galaxies between 408 MHz and 23 GHz, with a synchrotron spectral index that is flattest ($\beta_{\text{sub s}}$ approx. -2.5) near star-forming regions, especially in the plane, and steepest ($\beta_{\text{sub s}}$ approx. -3) in the halo. This is consistent with a picture of relativistic cosmic ray electron generation in star-forming regions and diffusion and convection within the plane. The significant synchrotron index steepening out of the plane suggests a diffusion process in which the halo electrons are trapped in the Galactic potential long enough to suffer synchrotron and inverse Compton energy losses and hence a spectral steepening. The synchrotron index is steeper in the WMAP bands than in lower frequency radio surveys, with a spectral break near 20 GHz to $\beta_{\text{sub s}}$ less than -3. The modeled thermal dust spectral index is also steep in the WMAP bands, with $\beta_{\text{sub d}}$ approx. = 2.2. Our model is driven to these conclusions by the low level of total foreground contamination at approx. 60 GHz. Microwave and H α measurements of the ionized gas agree well with one another at about the expected levels. Spinning dust emission is limited to less than 5% of the Ka-band foreground emission. A catalog of 208 point sources is presented. The reliability of the catalog is 98%, i.e., we expect five of the 208 sources to be statistically spurious. The mean spectral index of the point sources is α approx. 0 (β approx. -2). Derived source counts suggest a contribution to the anisotropy power from unresolved sources of $(15.0 \pm 1.4) \times 10^{-3} \text{ mJy sr}^{-1} \text{ K}^{-1}$ at Q-band and negligible levels at V-band and W-band. The Sunyaev-Zeldovich effect is shown to be a negligible 'contamination' to the maps.

Author

Microwave Anisotropy Probe; Emission; Galaxies; Mapping; Sky Surveys (Astronomy); Temperature; Cosmic Microwave Background Radiation; Galactic Structure

20030053452 NASA Marshall Space Flight Center, Huntsville, AL, USA

Evidence for Subauroral Electric Fields from IMAGE EUV

Six, N. Frank, Technical Monitor; Gallagher, D.; Adrian, M.; Goldstein, J.; Sandel, B.; [2002]; 1 pp.; In English; AGU Fall Meeting, 5-11 Dec. 2002, San Francisco, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

The IMAGE Mission Extreme Ultraviolet Imager routinely provides global snapshots of the plasmasphere from high latitude. In these 10-minute images, intensity edges have been identified with the plasmopause and other strong gradients in plasmaspheric density. In addition to the classic sunward directed convection tail and its entrainment in corotation during storm-time recovery, the plasmopause boundary reveals a wide variety of structures thought to result from penetration of the solar wind induced convection electric field to subauroral latitudes. The so-called shoulder feature has most prominently been discussed in the context of under shielding in response to changes in the convection electric field strength. It is not yet clear whether all of the observed surface structures on the plasmasphere can be explained in this manner. The types of structures observed and their frequency of occurrence will be presented. A statistical view of these structures and associated solar wind conditions will also be presented.

Author

Plasmopause; Solar Wind; Boundary Layer Plasmas; Electric Fields; Solar Convection (Astronomy)

20030054346 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Propagation of Light Elements in the Galaxy

Moskalenko, I. V.; Strong, A. W.; Mashnik, S. G.; Jones, F. C.; March 27, 2003; 1 pp.; In English; 28th ICRC, 31 Jul. - 7 Aug. 2003, Japan; Copyright; Avail: Other Sources; Abstract Only

The origin and evolution of isotopes of the lightest elements d, He-3, Li, Be, and B in the universe is a key problem in such fields as astrophysics of CR, Galactic evolution, non-thermal nucleosynthesis, and cosmological studies. One of the major sources of these species is spallation by CR nuclei in the interstellar medium. On the other hand, it is the Boron/Carbon ratio in CR and Be-10 abundance which are used to fix the propagation parameters and thus spallation rate. We study production and Galactic propagation of these species using the numerical propagation code GALPROP and updated production cross sections.

Author

Beryllium Isotopes; Boron; Carbon; Galactic Evolution; Helium Isotopes

20030054374 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Propagation Model for Cosmic Ray Species in the Galaxy

White, Nicholas E., Technical Monitor; Moskalenko, I. V.; Jones, F. C.; Ptuskin, V. S.; Strong, A. W.; Mashnik, S. G.; [2002]; 1 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

During the last decade there have been a number of space and balloon experiments with improved sensitivity and statistics, which impose stricter constraints on cosmic ray propagation models. Propagation is the main issue in the interpretation of such data as antiproton and positron fluxes in cosmic rays, and diffuse gamma-ray emission. We develop a new propagation model that reproduces measurements of secondary antiprotons as well as primary and secondary nuclei. We will present results of our calculation of CR propagation in the Galaxy for this model using the GALPROP code.

Author

Galactic Cosmic Rays; Propagation; Nuclei (Nuclear Physics); Mathematical Models

20030054390 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Characteristics of Transients in the Galactic Bulge

Swank, Jean H.; Markwardt, C. B.; White, Nicholas E., Technical Monitor; December 04, 2002; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Biweekly X-ray observations of the Galactic Bulge with the Rossi X-Ray Timing Explorer Proportional Counter Array for 5 years have built up statistics for different kinds of source behavior for low-mass binaries with neutron stars. The relation between the characteristic behaviors is not known. A typical transient may rise fast and decay exponentially in brightness and repeat this cycle after short (1/2 yr) or long intervals (20 yr). But an X-ray source also may be steady for an extended period (years) before the disk can become quiescent. It fades in the same way as do the transients which immediately decay. These sources have been reported to be very cool in quiescence; either not substantially heated by outbursts, or cooled very quickly. There are 3 sources active during the last 5 years which were long lasting transients which turned off and 1 which turned on. We will compare their X-ray characteristics in outburst, and in so far as available with Chandra, in quiescence.

Author

X Ray Astronomy; Galactic Bulge; X Ray Sources; Neutron Stars; Binary Stars

20030054500 NASA Ames Research Center, Moffett Field, CA, USA

The Shock Structure of Supernova Remnant IC443

Haas, Michael R.; Higdon, S. J. U.; Burton, M. G.; Hollenbach, D. J.; Fonda, Mark, Technical Monitor; March 31, 2003; 1 pp.; In English; American Astronomical Meeting, 25-29 May 2003, Nashville, TN, USA

Contract(s)/Grant(s): RTOP 263-10-30; Copyright; Avail: Other Sources; Abstract Only

We present and discuss ISO observations of IC443, a supernova remnant interacting with a molecular cloud. An SWS spectrum centered on molecular hydrogen clump R10E (RA(2000) = 6 17 7.6, Decl(2000) = 22 25 34.6) is dominated by strong [SiII] (34 microns) emission and the pure rotational transitions of molecular hydrogen ranging from 0-0 S(1) to 0-0 S(13). Fits to these H₂ lines imply a large column (approx. 7E19 cm⁻²) of warm (T approx. 700 K) gas and an ortho/para ratio for hydrogen near 3. LWS Fabry-Perot spectra of [OI] (63 microns) and [CII] (158 microns) at positions R10E and C (RA(2000) = 6 17 42.8, Decl(2000) = 22 21 38.1) find broad (approx. 75 km/s), blue-shifted (-40 km/s) line profiles; their similarity strongly suggests a common, shock-generated origin for these two lines. The surprisingly large [CII]/[OI] ratio (approx. 0.1 to 0.2) confirms previous observations with the Kuiper Airborne Observatory. These [CII] and [OI] line intensities, the [SiII] intensity (above), and LWS grating measurements of OH (119 microns) and [OI] (145 microns) are all readily fit by a single, fast J-shock model. Although the [OI] (63) emission can alternatively be produced by a slow C-shock, this ensemble of lines can not be produced by such a shock and provides strong evidence for the existence of a J-shock. A 24-arcmin strip map shows that this far-infrared line emission is spatially correlated with the H₂-2S 1-0 S(1) emission, which most likely arises in an associated C-shock. In addition to this spatially correlated shock emission, the strip map identifies extended [CII] and [OI] emission with a significantly larger line ratio (approx. 0.6); this 'background' component is compared with current J-shock, C-shock, photo-dissociation region (PDR), and X-ray dissociation region (XDR) models in an effort to explain its origin.

Author

Supernova Remnants; Shock Wave Interaction; Molecular Clouds; Emission Spectra

20030054561 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Simultaneous UV and X-ray Spectroscopy of the Seyfert 1 Galaxy NGC 5548. I: Physical Conditions in the UV Absorbers

Crenshaw, D. M.; Kraemer, S. B.; Gabel, J. R.; Kaastra, J. S.; Steenbrugge, K. C.; Brinkman, A. C.; Dunn, J. P.; George, I. M.; Liedahl, D. A.; Paerels, F. B. S., et al.; [2003]; 33 pp.; In English

Contract(s)/Grant(s): NAS5-26555; NAG5-4103; NAG5-7584; Copyright; Avail: CASI; [A03](#), Hardcopy

We present new UV spectra of the nucleus of the Seyfert 1 galaxy NGC 5548, which we obtained with the Space Telescope Imaging Spectrograph at high spectral resolution, in conjunction with simultaneous Chandra X-ray Observatory spectra. Taking advantage of the low UV continuum and broad emission-line fluxes, we have determined that the deepest UV absorption component covers at least a portion of the inner, high-ionization narrow-line region (NLR). We find nonunity covering factors in the cores of several kinematic components, which increase the column density measurements of N V and C IV by factors of 1.2 to 1.9 over the full-covering case; however, the revised columns have only a minor effect on the parameters derived from our photoionization models. For the first time, we have simultaneous N V and C IV columns for component 1 (at -1040 km/s), and find that this component cannot be an X-ray warm absorber, contrary to our previous claim based on nonsimultaneous observations. We find that models of the absorbers based on solar abundances severely overpredict the O VI columns previously obtained with the Far Ultraviolet Spectrograph, and present arguments that this is not likely due to variability. However, models that include either enhanced nitrogen (twice solar) or dust, with strong depletion of carbon in either case, are successful in matching all of the observed ionic columns. These models result in substantially lower ionization parameters and total column densities compared to dust-free solar-abundance models, and produce little O VII or O VIII, indicating that none of the UV absorbers are X-ray warm absorbers.

Author

Ultraviolet Spectroscopy; X Ray Spectroscopy; Ultraviolet Astronomy; X Ray Astronomy; Seyfert Galaxies; Absorption Spectra

91

LUNAR AND PLANETARY SCIENCE AND EXPLORATION

Includes planetology; selenology; meteorites; comets; and manned and unmanned planetary and lunar flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance*.

20030053330 Colorado Univ., Boulder, CO, USA

Small Scale Polygons and the History of Ground Ice on Mars

Mellon, Michael T.; [2003]; 3 pp.; In English

Contract(s)/Grant(s): NAG5-10155; No Copyright; Avail: CASI; [A01](#), Hardcopy

Recent progress on polygon modeling has focused on the diameter and surface relief that we expect of thermal-contraction polygons in martian permafrost. With this in mind, we developed a finite-element model of thermal-contraction-crack behavior in permafrost in a martian climate. This model was generated from a finite element code by Jay Melosh (called TECTON) originally developed for terrestrial and planetary crustal-deformation studies. We adapted this model to martian permafrost by including time (and temperature) dependent rheologies, boundary conditions, and isotropic thermal-contraction, as well as several small adaptations to a martian environment. We tested our model extensively, including comparison to an analytic solution of pre-fracture stress. We recently published an analysis of two potential sources of water for forming the recent gullies. In this work we first evaluated the potential for near-surface ground ice (in the top meter or so of soil) to melt under conditions of solar heating on sloped surfaces at high obliquity, utilizing both thermal and diffusion-based ground-ice-stability models; our results suggested that the ground ice will sublimate, and the ice table will recede to greater depths before the melting temperature can be reached. An exception can occur only for extremely salt-rich ice, depressing the freezing point. Derived from text

Mars Surface; Planetary Geology; Ice; Polygons; Mathematical Models; Crack Propagation; Crustal Fractures

20030054399 Arizona Univ.

Optical Dust Characterization in Manned Mars Analogue Research Stations

Bos, B. J.; Krebs, Carolyn, Technical Monitor; [2003]; 1 pp.; In English; Mars Society Conference Proceedings, Burlington, Ontario, Canada; No Copyright; Avail: Other Sources; Abstract Only

Martian dust has been identified as a potentially serious hazard to any manned Mars landing mission. NASA and other organizations realize this risk and continue to support Martian dust research through the Matador project led by researchers

at the University of Arizona. The Mars Society can contribute to this work by beginning a regimen of monitoring and measuring dust properties at its Mars analogue research stations. These research facilities offer the unique opportunity to study the transport and distribution of dust particles within a crewed habitat supporting active geologic exploration. Information regarding the amount, location and size of dust particles that may accumulate in a Mars habitat will be required to design a real Mars habitat and habitat equipment. Beginning such an effort does not require a large outlay of equipment and can be accomplished using crewmembers experienced with station operations. Various optical techniques, such as dark-field illumination, coupled with image processing algorithms enable the collection of dust grain relative size and frequency information. Such approaches can be applied in several different zones within the research stations to evaluate the various dust reduction and isolation procedures implemented during a particular crew rotation. As the stations simulation fidelity increases, the applicability of such data to a functional Mars lander will increase. This presentation describes the optical equipment and procedures for measuring dust properties in Mars analogue research stations that can be implemented during the next field season.

Author

Manned Mars Missions; Dust; Grain Size; Particle Size Distribution; Mars Environment; Mars (Planet); Environment Simulation

20030054495 NASA Ames Research Center, Moffett Field, CA, USA

Understanding of Jupiter's Atmosphere after the Galileo Probe Entry

Fonda, Mark, Technical Monitor; Young, Richard E.; [2003]; 1 pp.; In English; Entry Probe Workshop, 21-22 Apr. 2003, Boulder, CO, USA

Contract(s)/Grant(s): RTOP 344-50-92-02; No Copyright; Avail: Other Sources; Abstract Only

Instruments on the Galileo probe measured composition, cloud properties, thermal structure, winds, radiative energy balance, and electrical properties of the Jovian atmosphere. As expected the probe results confirm some expectations about Jupiter's atmosphere, refute others, and raise new questions which still remain unanswered. This talk will concentrate on those aspects of the probe observations which either raised new questions or remain unresolved. The Galileo probe observations of composition and clouds provided some of the biggest surprises of the mission. Helium abundance measured by the probe differed significantly from the remote sensing derivations from Voyager. Discrepancy between the Voyager helium abundance determinations for Jupiter and the Galileo probe value have now led to a considerably increased helium determination for Saturn. Global abundance of N in the form of ammonia was observed to be super-solar by approximately the same factor as carbon, in contrast to expectations that C/N would be significantly larger than solar. This has implications for the formation and evolution of Jupiter. The cloud structure was not what was generally anticipated, even though most previous remote sensing results below the uppermost cloud referred to 5 micron hot spots, local regions with reduced cloud opacity. The Galileo probe descended in one of these hot spots. Only a tenuous, presumed ammonium hydrosulfide, cloud was detected, and no significant water cloud or super-solar water abundance was measured. The mixing ratios as a function of depth for the condensibles ammonia, hydrogen sulfide, and water, exhibited no apparent correlation with either condensation levels or with each other, an observation that is still a puzzle, although there are now dynamical models of hot spots which show promise in being able to explain such behavior. Probe tracked zonal winds show that wind magnitude increases with depth to pressures of about 4 bars, with the winds extending to at least as deep as the probe made measurements, 22 bars. Models of hot spot dynamics raise the possibility that the variation with depth of the probe measured zonal winds between 0.4 and 4 bars reflect the dynamics of the hot spot rather than the global wind pattern. Galileo upper atmosphere measurements established that there is a sharp temperature rise with altitude between about 350 and 800 km above the 1 bar pressure level, with the upper atmosphere reaching temperatures near 900 K. The energy sources for this upper atmosphere heating are not clearly established, but various mechanisms have been proposed. These and other aspects of the Galileo probe data will be discussed.

Author

Galileo Probe; Jupiter Atmosphere; Atmospheric Composition; Atmospheric Energy Sources; Cloud Physics; Planetary Meteorology

92
SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots. For related information see *93 Space Radiation*.

20030053171 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Electron Bremsstrahlung Hard X-Ray Spectra, Electron Distributions and Energetics in the 2002 July 23 Solar Flare

Holman, G. D.; Sui, L.; Schwartz, R. A.; Emslie, A. G.; [2003]; 2 pp.; In English; 34th Meeting of the AAS Solar Physics Division, 16-20 Jun. 2003, Laurel, MD, USA; Copyright; Avail: Other Sources; Abstract Only

We present and analyze the first high-resolution hard X-ray spectra from a solar flare observed in both X-ray/gamma-ray continuum and gamma-ray lines. The 2002 July 23 flare was observed by the Ramaty High Energy Solar Spectroscopic Imager (RHESSI). The spatially integrated photon flux spectra are well fitted between 10 and 300 keV by the combination of an isothermal component and a double power law. The flare plasma temperature peaks at 40 MK around the time of peak hard X-ray emission and remains above 20 MK 37 min later. We derive the evolution of the nonthermal mean electron flux distribution by directly fitting the RHESSI X-ray spectra with the thin-target bremsstrahlung from a double power-law electron distribution with a low-energy cutoff. We also derive the evolution of the electron flux distribution on the assumption that the emission is thick-target bremsstrahlung. We find that the injected nonthermal electrons are well described throughout the flare by this double power-law distribution with a low-energy cutoff that is typically between 20 - 40 keV. Using our thick-target results, we compare the energy contained in the nonthermal electrons with the energy content of the thermal flare plasma observed by RHESSI and GOES. We find that the minimum total energy deposited into the flare plasma by nonthermal electrons, 2.6×10^{31} erg, is on the order of and possibly less than the energy in the thermal plasma. However, these fits do not rule out the possibility that the energy in nonthermal electrons exceeds the energy in the thermal plasma. This work was supported in part by the RHESSI Project and the NASA Sun-Earth Connection program.

Author

Electron Energy; Bremsstrahlung; X Ray Spectra; Electron Distribution; Solar Flares; X Ray Astronomy; Gamma Ray Astronomy

20030053185 NASA Goddard Space Flight Center, Greenbelt, MD, USA

DEM Measurements of Moving UV Features in Prominences

Oegerle, William, Technical Monitor; Kucera, T. A.; Landi, E.; [2003]; 1 pp.; In English; 34th Meeting of the AAS Solar Physics Division, 16-20 Jun. 2003, Laurel, MD, USA

Contract(s)/Grant(s): RTOP 432-03-52-17; No Copyright; Avail: Other Sources; Abstract Only

Multi-thermal features with speeds of 5-70 km/s perpendicular to the line of sight are common in the prominences which showed traceable motions. These speeds are noticeably higher than the typical speeds of 5-20 km/s observed in H-alpha data from 'quiet' prominences and are more typical of 'activated' prominences in which H-alpha blob speeds of up to 40 km/s have been reported. In order to make a more quantitative determination of the thermal properties of the moving features seen in the UV, we use the SOHO Coronal Diagnostic Spectrometer to take a time series of exposures from a single pointing position, providing a measurement of spectral line properties as a function of time and position along the slit. The resulting observations in lines of O III, O IV, O V, Ne IV, Ne V, Ne VI, and Ne VII allow us to calculate the differential emission measure of moving features and provide a test of models of flows in prominences.

Author

Solar Prominences; Line Spectra; Thermodynamic Properties; Digital Elevation Models; Ultraviolet Radiation

20030053189 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Investigation of Solar Flares Using Spectrally, Spatially, and Temporally Resolved Observations in Gamma Rays, Hard X Rays, and Microwaves

Crannell, Carol Jo; Oegerle, William, Technical Monitor; [2003]; 1 pp.; In English; Shapely Lecture, Bloomsburg, PA; No Copyright; Avail: Other Sources; Abstract Only

The high-energy components of solar flares radiate at a wide range of wavelengths. We are using spatially, spectrally, and temporally resolved hard X-ray, gamma-ray, and microwave observations of solar flares to investigate flare models and to understand the flare acceleration process. The hard X-ray and gamma-ray observations are obtained with the Reuven Ramaty High-Energy Solar Spectroscopic Imager (RHESSI) spacecraft that was launched on February 5, 2002. The microwave observations are obtained with the Owens Valley Radio Observatory (OVRO), which has been dedicated to daily observations of solar flares in microwaves with a five-element interferometer since June 1992. These studies are expected to yield exciting

new insights into the fundamental physics of the flare acceleration processes.

Author

Solar Flares; Gamma Ray Astronomy; X Ray Astronomy; Imaging Spectrometers; Acceleration (Physics)

20030053372 NASA Goddard Space Flight Center, Greenbelt, MD, USA

RHESSI Observations of Flares During the Storms Period from 14 to 24 April 2002

Rabin, Douglas, Technical Monitor; Dennis, Brian R.; Gallagher, Peter T.; [2002]; 1 pp.; In English; AGU Fall Meeting Workshop, 6-10 Dec. 2003, San Francisco, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

The Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) observes X-rays and gamma rays from solar flares in the energy range from 3 keV to 17 MeV with a duty cycle of about 50%. The RHESSI observations of the flares during the Storms Workshop period from 14 to 24 April, 2002, will be reviewed. Many Geostationary Operational Environmental Satellites (GOES) C- and M-class flares were observed including the M2.6 flare on 17 April that was followed by a Coronal Mass Ejection (CME). The X1.5 flare on 21 April was particularly well observed with RHESSI in X-rays from its start at 00:40 UT until 01:33 UT on the first orbit, just before the soft X-ray peak. Footpoint emission was detected to energies as high as 200 keV, and a spatially-separated coronal source was identified at energies below about 30 keV. The coronal X-ray source was followed for over 12 more hours on subsequent orbits as it gradually rose to over 130,000 km above the limb. The X-ray images and spectra of this flare will be presented in relation to the Transitional Region and Coronal Explorer (TRACE) images in the 195-angstrom band and the Large Angle and Spectrometric Coronagraph Experiment (LASCO) images of the associated CME.

Author

Imaging Techniques; Solar Flares; Solar Physics; X Ray Astronomy; Observation; Astronomical Spectroscopy

20030053421 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Chemical Data Assimilation: A Case Study of Solar Occultation Data From the Atlas 1 Mission of the Atmospheric Trace Molecule Spectroscopy Experiment

Lary, D. J.; Khattatov, B.; Mussa, H.; [February 2003]; 12 pp.; In English; Original contains color illustrations; Copyright; Avail: CASI; [A03](#), Hardcopy

A key advantage of using data assimilation is the propagation of information from data-rich regions to data-poor regions, which is particularly relevant to the use of solar occultation data such as from ATMOS. For the first time an in depth uncertainty analyses is included in a photochemical model-data intercomparison including observation, representativeness, and theoretical uncertainty. Chemical data assimilation of solar occultation measurements can be used to reconstruct full diurnal cycles and to evaluate their chemical self-consistency. This paper considers as an example the measurements made by the Atmospheric Trace Molecule Spectroscopy Experiment (ATMOS) instrument Atlas-1 during March 1992 for a vertical profile flow tracking coordinates at an equivalent PV latitude of 38 S. ATMOS was chosen because it simultaneously observes several species. This equivalent PV latitude was chosen as it was where ATMOS observed the atmosphere's composition over the largest range of altitudes. A single vertical profile was used so that the detailed diurnal information that assimilation utilizes could be highlighted. There is generally good self-consistency between the ATMOS Atlas-1 observations and photochemical theory.

Author

Data Processing; Solar Position; Solar Eclipses; Assimilation

20030053447 NASA Marshall Space Flight Center, Huntsville, AL, USA

Relation between Pressure Balance Structures and Polar Plumes from Ulysses High Latitude Observations

Yamauchi, Yohei; Suess, Steven T.; Sakurai, Takashi; Geophysical Research Letters; [2002]; ISSN 0094-8276; Volume, 29, pp. 21-1 - 21-4; In English; Copyright; Avail: Other Sources

Ulysses observations have shown that pressure balance structures (PBSs) are a common feature in high-latitude, fast solar wind near solar minimum. Previous studies of Ulysses/SWOOPS plasma data suggest these PBSs may be remnants of coronal polar plumes. Here we find support for this suggestion in an analysis of PBS magnetic structure. We used Ulysses magnetometer data and applied a minimum variance analysis to magnetic discontinuities in PBSs. We found that PBSs preferentially contain tangential discontinuities, as opposed to rotational discontinuities and to non-PBS regions in the solar wind. This suggests that PBSs contain structures like current sheets or plasmoids that may be associated with network activity at the base of plumes.

Author

Solar Magnetic Field; Solar Wind; Shock Waves; Solar Corona; Magnetic Field Configurations; Solar Physics; Pressure Distribution; Discontinuity

20030053450 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Comparison of Time-Distance Local Helioseismology on GONG and MDI Data Sets

Duvall, T. L., Jr.; Zhao, J.; Rajaguru, S. P.; Toner, C. G.; Kosovichev, A. G.; Thompson, M. J.; Hughes, S. J.; [2003]; 1 pp.; In English; Solar Physics Division 2003, 16-20 Jun. 2003, Laurel, MD, USA; Copyright; Avail: Other Sources; Abstract Only

We show first results derived from one rotation of GONG++ and MDI data analyzed independently by different groups with time-distance techniques. We focus on observations obtained during spring 2002 and especially on Carrington rotation 1988 (2002/3/30 - 2002/4/26) and measure flow components and wave speed inhomogeneities over a range of depths for different active regions.

Author

Time Dependence; Distance; Helioseismology

20030053777 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Electron Bremsstrahlung Hard X-Ray Spectra, Electron Distributions and Energetics in the 2002 July 23 Solar Flare

Holman, Gordon D.; Sui, Lindhui; Schartz, Richard A.; Emslie, A. Gordon; Oegerle, William, Technical Monitor; [2003]; 2 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

We present and analyze the first high-resolution hard X-ray spectra from a solar flare observed in both X-ray/gamma-ray continuum and gamma-ray lines. The 2002 July 23 flare was observed by the Ramaty High Energy Solar Spectroscopic Imager (RHESSI). The spatially integrated photon flux spectra are well fitted between 10 and 300 keV by the combination of an isothermal component and a double power law. The flare plasma temperature peaks at 40 MK around the time of peak hard X-ray emission and remains above 20 MK 37 min later. We derive the evolution of the nonthermal mean electron flux distribution by directly fitting the RHESSI X-ray spectra with the thin-target bremsstrahlung from a double power-law electron distribution with a low-energy cutoff. We also derive the evolution of the electron flux distribution on the assumption that the emission is thick-target bremsstrahlung. We find that the injected nonthermal electrons are well described throughout the flare by this double power-law distribution with a low-energy cutoff that is typically between 20-40 keV. Using our thick-target results, we compare the energy contained in the nonthermal electrons with the energy content of the thermal flare plasma observed by RHESSI and GOES. We find that the minimum total energy deposited into the flare plasma by nonthermal electrons, 2.6×10^{31} erg, is on the order of and possibly less than the energy in the thermal plasma. However, these fits do not rule out the possibility that the energy in nonthermal electrons exceeds the energy in the thermal plasma.

Author

X Ray Spectra; Gamma Rays; Plasmas (Physics); Solar Flares; Electron Energy

20030054356 NASA Goddard Space Flight Center, Greenbelt, MD, USA

SOHO/CDS Measurements of Coronal EUV Polarization above the Limb

Thomas, Roger J.; [2002]; 1 pp.; In English; Third International Workshop on Solar Polarization, 28 Sep. - 5 Oct. 2002, Spain; No Copyright; Avail: Other Sources; Abstract Only

Attempts to measure polarization in coronal extreme ultraviolet (EUV) emission above the solar limb have been made using the SOHO/CDS normal-incidence spectrometer which has a polarization sensitivity of about 50%, a property that causes variations in intensity response as a function of the spacecraft's roll angle for polarized light. Such observations were made on the disk and up to 0.22 solar radii above the solar limb in a number of EUV lines during two special roll-maneuvers of the SOHO spacecraft. Measurements of intensity gradients were made above a modestly active equatorial region in 1997 and above a relatively cool polar region in 2001. Observed emission lines include He I 584 Å, He II 304 Å, O IV 555+610 Å, O V 630 Å, Mg IX 368 Å, Mg X 610+625 Å, and Si XI 303 Å, formed at temperatures that evenly cover the range in log T from 4.1 to 6.2. Near the disk, measured intensities of all lines fall off exponentially at different rates that can be used to determine the density scale-heights of the emitting plasma, since this emission is dominated by collisional excitation with an Ne-squared dependence. Assuming hydrostatic equilibrium, the intensity gradient for each line can then be converted into a 'scale-height temperature', which is found to be closely related to the ionization temperature of each line over the wide range of lines and solar conditions observed. Thus the large-scale corona is remarkably uniform, even though clearly displaying a great deal of structure and non-uniformity on smaller spatial scales. Beyond a certain distance, intensity gradients of the cooler lines switch over to a flatter exponential slope, suggesting that this radiation is dominated by resonance scattering which varies as Ne to the first power. Such radiation should also be linearly polarized in the plane containing the line-of-sight and the solar center, a signature that would strongly confirm this interpretation.

Author

Solar Corona; Extreme Ultraviolet Radiation; Ultraviolet Astronomy; Solar Limb; Polarized Electromagnetic Radiation

20030054367 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Theoretical Model Images and Spectra for Comparison with HESSI and Microwave Observations of Solar Flares

Fisher, Richard R., Technical Monitor; Holman, G. D.; Sui, L.; McTiernan, J. M.; Petrosian, V.; [2003]; 1 pp.; In English; Yohkoh 10th Anniversary Meeting; Copyright; Avail: Other Sources; Abstract Only

We have computed bremsstrahlung and gyrosynchrotron images and spectra from a model flare loop. Electrons with a power-law energy distribution are continuously injected at the top of a semi-circular magnetic loop. The Fokker-Planck equation is integrated to obtain the steady-state electron distribution throughout the loop. Coulomb scattering and energy losses and magnetic mirroring are included in the model. The resulting electron distributions are used to compute the radiative emissions. Sample images and spectra are presented. We are developing these models for the interpretation of the High Energy Solar Spectroscopic Imager (HESSI) x-ray/gamma ray data and coordinated microwave observations. The Fokker-Planck and radiation codes are available on the Web at <http://hesperia.gsfc.nasa.gov/hessi/modelware.htm> This work is supported in part by the NASA Sun-Earth Connection Program.

Author

Astronomical Models; Solar Flares; Solar Spectra; Coronal Loops; Coulomb Collisions; Electron Distribution; Steady State; Energy Dissipation; Fokker-Planck Equation

20030054405 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Fixed Pattern Correction and Rapid Analysis Procedures for He I 1083 nm Imaging Spectroscopy with the NASA/NSO Spectromagnetograph

Jones, Harrison P.; [2003]; 17 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): RTOP 344-12-52-14; RTOP 344-12-52-19; No Copyright; Avail: CASI; [A03](#), Hardcopy

Imaging spectroscopy in the He 1083 nm lines is a powerful tool for probing the top of the chromosphere and bottom of the transition region. A method for spectral flat-fielding using a uniform solar exposure with spectral lines in place is presented and illustrated with 1083 nm data obtained with the NASA/NSO Spectromagnetograph at the National Solar Observatory Kitt Peak Vacuum Telescope. An efficient method for analysis of the data producing images in continuum intensity, line-of-sight velocity, equivalent width, central line depth, Doppler width, and line asymmetry is also presented and illustrated.

Author

Helium Isotopes; Spectroscopy; Imaging Techniques; Spectral Line Width; Data Processing

93

SPACE RADIATION

Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see *51 Life Sciences*; on human beings see *52 Aerospace Medicine*. For theory see *73 Nuclear Physics*.

20030053172 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Single-Event Effects Ground Testing and On-Orbit Rate Prediction Methods: The Past, Present and Future

Reed, Robert A.; Kinnison, Jim; Pickel, Jim; Buchner, Stephen; Marshall, Paul W.; Kniffin, Scott; LaBel, Kenneth A.; [2003]; 18 pp.; In English; 2003 IEEE Nuclear and Space Radiation Effects Conference, 21-25 Jul. 2003; Copyright; Avail: CASI; [A03](#), Hardcopy

Over the past 27 years, or so, increased concern over single event effects in spacecraft systems has resulted in research, development and engineering activities centered around a better understanding of the space radiation environment, single event effects predictive methods, ground test protocols, and test facility developments. This research has led to fairly well developed methods for assessing the impact of the space radiation environment on systems that contain SEE sensitive devices and the development of mitigation strategies either at the system or device level.

Author

Ground Tests; Single Event Upsets; Aerospace Environments; Mathematical Models; Extraterrestrial Radiation

99
GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs such as Apollo, Gemini, and Mercury spacecraft, Earth Resources Technology Satellite (ERTS), and Skylab; NASA appropriations hearings.

20030054378 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Visions of our Planet's Atmosphere, Land and Oceans

Hasler, A. F.; [2002]; 1 pp.; In English; 18th International CODATA Conference, 30 Sep. - 3 Oct. 2002, Montreal, Canada; No Copyright; Avail: Other Sources; Abstract Only

The NASA/NOAA Electronic Theater presents Earth science observations and visualizations in a historical perspective. Fly in from outer space to South Africa, Cape Town and Johannesburg using NASA Terra/MODIS data, Landsat data and 1 m IKONOS 'Spy Satellite' data. Zoom in to any place South Africa using Earth Viewer 3D from Keyhole Inc. and Landsat data at 30 m resolution Go back to the early weather satellite images from the 1960s and see them contrasted with the latest US and international global satellite weather movies including hurricanes & 'tornadoes'. See the latest visualizations of spectacular images from NASANOAA remote sensing missions like Terra, GOES, TRMM, SeaWiFS, Landsat 7 including 1 - min GOES rapid scan image sequences of Nov 9th 2001 Midwest tornadic thunderstorms and have them explained.

Author

Multimedia; High Definition Television; Public Relations

Subject Term Index

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